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**THESIS**

**AN EXAMINATION OF INDIVIDUAL PERFORMANCE  
USING MARKOV MODELS IN THE HELLENIC NAVY'S  
OFFICER-PERFORMANCE EVALUATION SYSTEM**

by

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March 2012

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EVALUATION SYSTEM**

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## ABSTRACT

The recent financial-crisis that Greece (Hellas) suffers has restricted and reduced the budgets of many organizations. Among those, the Hellenic ministry of defense has begun examining ways to reduce costs while maintaining operational readiness. Retirement legislation is the first area the Hellenic ministry of defense is examining. Variables such as years of service required to receive a pension, years of service by pay grade, and the skills officers should possess for promotion were examined and recorded in ordinances (directives) issued by the president of the Hellenic Republic.

However, these ordinances are expected to expand the number of officers in the middle pay grades. In an attempt to deal with potential increases in middle and higher pay grades of officer inventory the Hellenic Ministry of Defense is examining an alternative plan of two parallel officer force structures: war and auxiliary. The primary structure will consist of war officers. These officers are considered top performers whose careers stop at the pay grade of flag officer. The auxiliary inventory includes those officers exhibiting lower performance with the terminal pay grade of captain. The purpose of these parallel paths is to ensure all officers serve 35 years in order to receive full pensions.

This thesis analyzed job performance from the perspective of experience, ability, motivation, and accomplishment of advanced degrees. It concluded that experience should be combined with education level as a reliable evaluation field. Through the use of weighting priorities, the Hellenic navy should establish job performance as a single number, or officer ranking. Thus, top performers are distinguished from officers with lower performance on periodic evaluations. Using Markov-chain models and officer scores on job performance, the war and auxiliary inventories were examined. The war inventory was then adjusted to corresponding billets at every pay grade during a five-year period. The auxiliary officers were examined for future vacancies in the war inventory.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

HAF	Hellenic Armed Forces
HMoD	Hellenic Ministry of Defense
HNA	Hellenic Naval Academy
HN	Hellenic Navy
HSI	Human System Integration
KSA	Knowledge Skills and Abilities
NRC	National Research Council
NPS	Naval Postgraduate School
NSC	Naval Supreme Council
ROI	Return on Investments
RHN	Royal Hellenic Navy
USM	United States Military
USN	United States Navy

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## I. INTRODUCTION

### A. BACKGROUND

The recent financial crisis that Greece (Hellas) suffers from, has restricted and reduced the budgets of many organizations. Among these, the Hellenic Ministry of Defense (HMoD) has begun examining ways to reduce expenses. Retirement cost is the first variable under examination. In 1996, the presidency of the Hellenic Republic issued an ordinance (Presidency of the Hellenic Republic, Ordinance A, 219/1996) regarding the structural development of officer careers throughout the Hellenic armed forces' pyramidal chain of command. Variables such as actual years of service required to receive a pension, time (minimum and maximum) in each pay grade, and skills officers should possess to be promoted were examined. These variables were identical for each of the three branches of the armed forces (army, navy, and air force).

For many years, a pyramidal shape has represented the force-structure development of officer inventory for the Hellenic navy (HN). However, the increasing number of accessions at the Hellenic Naval Academy (HNA) since the middle of the 1980s has caused an increase in officer inventory. Increases in accessions have caused serious problems in officer development at almost every pay grade. The worst problem appears in the middle pay grades, where the total numbers of officers has been over accessed.

To address this increased inventory of midgrade officers, the ordinance establishes three years-of-service periods that an officer should reach in order to receive a pension. The first period is at sixteen years of service (including years in the military academies), at which retirees could get a minimum pension. The second period is at 25 years of service, where an officer could get a moderate pension. Officers retiring after 35 years of service would receive a full pension. Currently the Hellenic Military has no limits regarding age. Thus, a 43-year-old officer who entered the HNA at the age of eighteen could retire and get a moderate pension.

To facilitate both the completion of years of service needed for a pension and the smooth flow of inventory (especially lieutenants [or O3s], lieutenant commanders [or O4s] and commanders [or O5s]), time in each pay grade were designated. In particular, thresholds for minimum and maximum years of service were established. As a result, the flow of officers at each pay grades was temporarily resolved and promotion procedures were implemented when officers completed the maximum required years of service in each pay grade.

The ordinance includes a general description of promotion qualifications. Some qualifications are related to merits and skills required by the job. These skills are related to educational background, operational knowledge and experience, or personality traits and tendencies (such as persistence, perception, cooperation, etc.) and the last category included distinguished merits (e.g. ability in flight operations). In other words, certain levels of qualification provide the basis by which an officer possessing “X” skills and merits would be considered a top performer.

Many organizations use some form of evaluation reports of personnel as a metric to measure an individual’s level of performance. The military emphasizes individual performance, which is included in the ordinance. The ordinance provides a general design of how to use fitness reports and explains the importance of these reports during selection for promotion. The ordinance does not include detailed instructions of how to fill out evaluations, and gives no specific criteria to secure any degree of objectivity.

The ordinance was initially successful, but due to the financial crisis, doubt has risen. Like other organizations, the HMoD is striving to reduce costs while maintaining operational readiness. Retirement legislation is the first among many areas to be examined. Regardless of age, officers are obliged to serve for 35 years (Presidency of the Hellenic Republic, Ordinance A' 120/2010) in order to receive a full pension. If they retire earlier (essentially resigning) than 35 years of service, they have to wait until age 60 to receive a pension. Furthermore, the pension they receive corresponds proportionally to their actual years of service. However, retirement legislation was not the only area examined. Required years of service in each pay grade were extended according to ordinance 167/A/2010. The outcome of the implementation of both new ordinances is

expected to expand the number of officers in the middle grades of the pyramid. In an attempt to deal with potentially greater inflation in the middle and higher pay grades, an alternative plan of two parallel officer inventories was proposed. The primary inventory will be war officers (very capable individuals who are considered top performers and whose career stops at flag-officer pay grades). The auxiliary inventory will include those officers with lower performance level and the terminal pay grade would be captain. The purpose of these parallel inventories is to ensure that all officer serving 35 years receive a full pension and avoid having to wait until age 60.

After almost 15 years since the President of the Hellenic Republic issued the ordinance regarding career development in the HAF, much has changed. The financial crisis has caused an immediate effect in the way every organization operates and, most importantly, has decreased their budgets.

## **B. PURPOSE**

The purpose of this thesis is to examine policies in order to facilitate the implementation of two parallel inventories for HN deck officers. The examination includes criteria regarding promotion by pay grades in the war inventory and, transfer to the parallel auxiliary. The research examines how to keep the total number of officers in the war inventory steady and how to adjust the distribution of officers by pay grade to the corresponding war-billets across a five-year horizon. This work includes an analysis on how to minimize the inflation of officers (existing billets in each pay grade versus the current population of deck officers). The thesis analyzes individual performance from different perspectives, assigns numerical values and determines how individual performance could be used as the principal criteria for officer selection for future war and auxiliary inventories.

## **C. RESEARCH QUESTIONS**

### **1. Primary Research Questions**

- Which promotion criteria meet required officer accessions so that only top performers track to war officer inventory?

- Can components such as experience, ability (performance), motivation, and attainment of advanced degrees reliably convert performance into a metric with numerical values?

## **2. Secondary Research Questions**

- What practices should be adopted to turn fitness reports into an objective tool for promotion?
- How can war and auxiliary inventories be estimated over five years?

## **D. BENEFITS OF THE STUDY**

This study provides decision makers with alternatives when examining parallel officer war and auxiliary inventories. Using numerical values for individual performance, decision makers will be able to score, select and promote only the most capable officers in the war inventory. Additionally, less capable officers will be transferred to the auxiliary inventory. Furthermore, the population of HN deck officers learn details about what individual performance essentially is and how it can be measured. Thus, the study serves as a guide to examining officer performance and indicating areas in which officers should further develop their qualifications. An individual's skill development contributes to the overall performance of the HN.

## **E. SCOPE OF THE STUDY**

The scope of this thesis will include the following:

Turning individual performances, expressed in words, into a numerical value, based on the primary components of experience, ability, motivation, and possession of advanced degrees (indicating level of education) and the secondary appropriate components of personality.

The establishment (based on numerical value of job performance) of the proper flow of officers (promotions), so that only top performers fill the existing war inventory billets.

## **F. RESEARCH METHODOLOGY**

The methodology used in this research consists of the following elements:

- A literature review of performance evaluation of textbooks and studies will be examined to the restated primary and secondary components and how these connect to the promotion, retention, and retirement rates of officers.
- An examination of HN officer-inventory totals (number of officers in each rank) will be conducted.
- A Markov-chain model is developed to compute the accessions/appropriate flow of officers needed to keep steady the number of war officers as a whole and to adjust their distribution in each pay grade to the corresponding billets, over a five-year period.
- The results will be summarized and conclusions discussed, along with recommendations for potential future policies that should be considered beyond the next five years.

## **G. ORGANIZATION OF THE STUDY**

The study is organized into five chapters. Chapter II provides a literature review of the main and secondary components of individual performance based on previous studies and related textbooks. Job performance is converted into a range of numerical values. Chapter III describes and justify the structural mechanism used to compute the right accessions flow of officers within the war inventory of the HN. Additionally, there is an analysis of the current distribution of officers in each pay grade and corresponding billets. Chapter IV incorporates the restated structural mechanism into the current sole chain of command so as to find the right measure of accessions flow of officers. Chapter V presents a summary of research, followed by conclusions and recommendations based on each research question. Future research recommendations are also given.

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## **II. LITERATURE REVIEW**

### **A. AN INTRODUCTION TO JOB PERFORMANCE**

Evaluating individual job performance within organizations is an extremely broad subject that can be approached from several directions. Essentially, it is related to human behavior in the performance of tasks, whether alone or as part of a team. Performance is inherently hard to measure. An organization is a living idea, because it is primarily based on a variety of people with different cultures and personalities who work together to achieve specific objectives and goals. McShane and Von Glinow write that every organization “differs in its cultural content; that is the relative ordering of values,”<sup>1</sup> and thus, given the huge diversity of different internal rules and regulations, job designs and goals, it can be said that every organization is a unique entity. A variety of job-performance measurements exist that align with organizational values. Based on the characteristics that separate civilian from military organizations, it is necessary to define job performance from a military perspective. In other words, though a number of definitions already exist, one must explore how a military’s unique culture, job design, rules, and goals shape job performance.

Even though job performance shapes organizational attributes, it primarily resides within each individual’s unique character. Models have been developed concerning individual elements and attributes; they can be referred to as “drivers” that control an individual’s behavior. In military organizations, the attribute of experience, in terms of actual years of service or years of tenure, along with ability and a number of other characteristics of an individual’s personality, make up these drivers. They should always be adapted to the characteristics that differentiate civilian from military organizations, and play an important role on the level of job performance. However, special attention should be given to one of the most important personality traits—internal forces of motivation. All individuals direct their actions based on how motivated they are to achieve the goals they have set for themselves and the goals of the organization. Nevertheless, the goal’s magnitude determines the amount of effort that each individual is willing to perform to achieve it.

Another important factor that is crucial within military environments is level of education. Military organizations, through fully funded educational programs offered to officers, essentially make an investment that will benefit the organization in the long run, since return on investment cannot be measured in the short run. In particular, postgraduate studies at the Naval Postgraduate School are fully funded programs for deck officers and studies are expected to have a positive effect on each officer's job performance in the long run. The expectations then move forward, yielding a positive effect on the organization's overall performance.

Defining individual performance for the military is a necessity, since it is often completely different from civilian organizations, due to its mission. "Destroy and kill enemies"<sup>2</sup> is the reason the military exists. Thus, military and civilian personnel of the military should be aligned with that distinguished mission and direct all their knowledge, skills, and abilities to serving. However, effort is not enough. They need appropriate material in order to do their jobs efficiently.

It is known that the environment in which a military operates varies depending on the nature of the operation. For the Hellenic navy, ships and services ashore are the main components that make up the operational environment.

Finally, though individual performance is hard to measure, the restated elements will become the means to turn it from an abstract idea into a range of numerical values. Such an action is a necessity, especially when top performers from a pool of individuals or officers have to be selected and promoted.

## **B. PERCEPTION OF INDIVIDUAL PERFORMANCE FROM THE MILITARY PERSPECTIVE.**

Job performance is simultaneously an abstract concept that one can approach from a number of directions and the most significant criterion affecting the overall success of an organization. Job performance is influenced by an organization's culture and operational framework. Civilian and military organizations differ significantly because of the primary mission that each one serves, along with a number of other

characteristics. These characteristics essentially set the job design of military organizations that frames organizational demands and measurements of job performance.

### 1. Basic Characteristics of Civilian Organizations

An organization is a living idea with human capital as its base that strives to earn a living for itself and attain its goals. A civil organization, or firm, or company, directs its hierarchical structure, traits, attitudes, behavioral doctrine, and frame of regulations in order to make the highest profit possible. These elements, along with discipline and employee personalities, create an organization's unique culture. That culture has a considerable impact on the workforce; moreover, it obliges workers indirectly to exhibit their highest possible level of individual performance so the company can achieve its goals (e.g., highest possible profit). Furthermore, technology is an integral part of civilian organizations. An advanced technology may replace workers if managers decide doing so is cost effective. The graphic of "Figure 1"<sup>3</sup> illustrates how a combination of workers (labor hours) and technology (capital) can be combined so as to minimize cost and maximize profits.

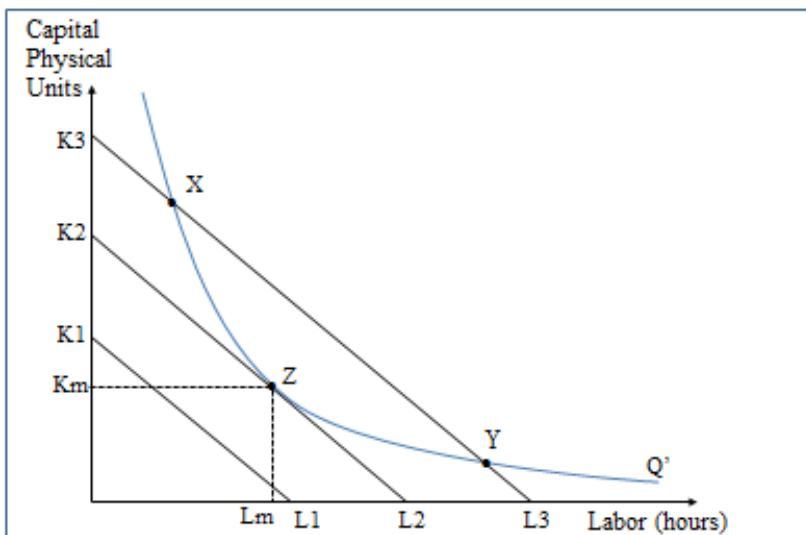


Figure 1. Cost minimization in production of profit-maximizing output (From <sup>3</sup>)

Isoquant  $Q'$  represents the profit-maximizing output. Lines  $K_1L_1$ ,  $K_2L_2$ ,  $K_3L_3$ , represent the total cost of the different combinations of labor hours (workers) and

(technology). Ehrenberg and Smith use this graphic to show that the tangent line of K2L2 to curve Q' gives the appropriate combination of humans/capital ( $L_m$ ,  $K_m$ ) that minimizes costs. Therefore, in the free market that dominates world commerce, civilian organizations have two basic characteristics:

- They strive with each other to attract high quality and very capable workers (top performers).
- They replace humans with capital, and the reverse, any time they wish, in order to achieve their goal of highest possible profit.

## **2. Basic Characteristics of Military Organizations**

Using the United States Military (USM), the National Research Council (NRC) sees such differences between military and corporate organizations in issues such as structure, downsizing, leadership, and inter-organizational cooperation. The NRC lists a number of characteristics within military organizations that do not appear in corporate organizations and underlines two points worth mentioning.

First, these differences are well known to those in the military, who live with them and their consequences. They are not usually articulated, so that these different features may routinely pass unnoticed by those not familiar with the military organization on a day-to-day basis. Second, the point is not merely that the military is subject to congressional rules. All organizations are subject to such structures. Fair labor practices, requirements of the Occupational safety and Health Administration, rules of the Securities and Exchange Commission, civil and criminal law, the Internal Revenue Code, and antitrust legislation, to name just a few, represent some of the legal regulations that define and constrain all organizations. It is the particular nature of the rules governing the military that makes its organizational operation so different.<sup>2</sup>

The points that follow describe thirteen characteristics of the restated military list and how they are related to the organization of the HN.

### **a. Military's Distinct Mission**

"First and foremost is the military's distinct mission. The military is the only organization with the mission to destroy and kill enemies of the nation. Neither

police nor police-like organizations, are authorized to kill in this manner.”<sup>2</sup> In other words, the military is allowed to make use of deadly force either in an aggressive or defensive manner so as to protect its nation’s interests from threats. There is no one other organization that operates in the same manner. As with the USM, officers of the HN, given the power that arises from deadly force aboard ships, have to support and accomplish the mission of the HN, which is the following:

Under the change of the dogma concerning the integrated defense of the areas of Greece and Cyprus in 1997, the navy aims to develop its power and domination into this strategically important area of the southeast Mediterranean. Its goals are to protect the Hellenic rights and border integrity, protect commercial sea-lines, and protect as well as cultivate a spirit of security to the Hellenic population of the Greek islands. Furthermore, it has the role of the transporter of supplies for the rest of the units of the armed forces and contributes mainly through Air transport to servicing the health needs of the population of the islands. Finally, the presence of the navy in the islands and especially in those of the eastern Aegean sea and the area of Corfu is constant. Hellenic Navy ships carry out patrolling missions in order to deal with any possible external threats and provide support to the Hellenic coast guard in central issues such as preventing illegal immigration, drug smuggling etc.<sup>4</sup>

#### ***b. Standard Budget***

To “raise and support Armies, but no Appropriation of Money to that Use shall be for a longer Term than two Years”<sup>5</sup> is what the U.S Constitution clearly defines, and the congress approves on a year by year basis, as the budget available for the military. Similarly, the Hellenic parliament decides the size of the Hellenic armed force’s budget (including that of the HN) in each fiscal year. When the budget is approved, it remains fixed throughout the current fiscal year (an exception exists whenever the government decides to acquire major equipment in either the sort or the long run). The fixed budget restrains the HN from planning operational activities beyond the current year. It also has a strong impact on the number of each year’s accessions, since they have to be fully aligned with the budget.

Furthermore, each individual has to demonstrate high levels of performance so as to accomplish the rapidly increasing number of tasks at the present time. National exercises that maintain high operational readiness, routine missions,

participation in worldwide taskforces against terrorism, and an additional number of subsequent tasks are complex parts of a deployment puzzle that every individual in the HN has to deal with and successfully accomplish. However, the accomplishment of these tasks must also be efficient. In other words, HN personnel should do their best to maintain and support the means through which naval operations are implemented, with minimal costs and sources.

Another human performance incentive is pay. In periods of limited budgets, unfortunately, the ability of decision makers to increase salaries and bonuses of personnel is minimal. On the contrary, the best option in this case is to maintain salaries at their current levels, while the worse scenario is to decrease them. These elements are compounded in todays Hellas, due to the financial crisis. The government, due to its commitments to the European Union and the International Monetary Fund, has already downsized the budget in every public organization. The magnitude of downsizing in the HAF budget from 2009, when the first signs of the crisis appeared, to 2012, in billions of Euros as shown in Figure 2.

Budget in the Hellenic Armed Forces Years:2009-2012					Percentage change
	2009	2010	2011	2012	
Personnel payments	2,874,616,000	2,804,820,000	2,280,000,000	2,193,200,000	-23,70%
Maintenance & supply expenditures	1,648,526,000	1,288,345,000	1,031,663,000	972,800,000	-40.99%
Acquisitions of major components	2,000,008,000	2,000,000,000	1,600,000,000	1,300,000,000	-25.00%
Total	6,523,140,000	6,093,165,000	4,911,663,000	4,666,000,000	-28.47%

Figure 2. Budget of Hellenic Armed Forces (From <sup>6</sup>)

Personnel payments have suffered a decline of 23.70% (from 2009 to 2012), whereas maintenance and supply expenditures have declined 40.99%. Nevertheless, today's personnel within the HAF are doing the same jobs as they did before the start of the

crisis. Even worse, they are facing an increasingly demanding environment of threats and global peace in general.

*c. Sets of Personnel*

Another similarity with the USM is the separate sets of personnel that comprise the workforce of the HN. Though active-duty service members are the majority, there are a significant number of civilian employees who hold key positions. This is especially true within the ministry of defense. They possess the power, by law, to decide a wide spectrum of issues such as personnel payments, maintenance and supply expenditures and acquisition of major components. The NRC notes that civilian personnel are “managed differently, evaluated differently, often held to different performance standards, and differ from each other in a number of other ways.”<sup>2</sup> One of those ways, which is extremely important, is that they have the power to preserve and defend their interests under the coverage of labor unions. Taylor, Arango, and Lockwood write, “The union is specifically empowered to collectively represent its members as a bargaining agent to secure benefits in excess of what the government is willing to offer.”<sup>7</sup> This definition shows the power that civilian personnel possess within military environments. Thus, officers, especially those of high rank (for whom military rules dominate their entire life), should have the ability to capture the social trends coming from civilian personnel within the HN and then manage them in an appropriate manner. Superior officers should promote effective team building among subordinates with different rules, perceptions, interests, social trends and principles.

*d. Rank Structure*

HN deck officers have a specific, pyramidal rank structure. Its main purpose is to facilitate, “the execution of orders through each echelon in the chain of command, insuring personal control at each step and final action only by the commander immediately responsible.”<sup>8</sup> The only source of HN deck officers are graduates of the Hellenic Naval Academy.

Upon graduating, a deck officer starts his career as an ensign, which corresponds to an O1 officer of the USM, and may retire as vice admiral, or O9. HN pay grades and their correspondence to USM officer ranks are shown in Table 1.

Table 1. Hellenic navy pay grades

Ensign or O1	Lieutenant Junior or O2	Lieutenant or O3
LT Commander or O4	Commander or O5	Captain or O6
Commodore or O7	Rear Admiral or O8	Vice Admiral or O9
	Admiral	

The billets in each layer of the pyramid are fixed by federal law. Thus, the HN cannot change its requirements on a short-term basis so as to increase or abolish billets to facilitate successful execution of its missions. This results in a certain number of officers who have to accomplish successfully every mission or task they undertake, no matter the mission. There is one option, under conditions of long-lasting heavy workload, the Navy can ask for increased accessions. However, such a request requires parliamentary approval. Furthermore, increased accessions will not result in an immediate increase in experienced and knowledgeable officers in the short run. It is worth mentioning that the whole organization is built upon the middle layers of the pyramid. That happens because middle-layer officers are between thirty and forty-five years old,

which means that they are simultaneously experienced and relatively young, and thus the most productive individuals within the organization. Deck officers must demonstrate high productivity in a short time to accomplish today's increasing numbers of missions and tasks.

*e. Pay Structure*

Rank and pay structures are equally important and fixed. Each individual in the organization brings unique traits, which include culture, personality, perceptual capability, etc. Additionally, some individuals are more productive than others. Unfortunately, the difference of productivity among officers is a shortcoming of a fixed-pay structure since those who exhibit high levels of production do not get paid proportionally, nor do they receive bonuses. Their merit is also not, nonmonetary, compensated (awards or metals) but rather HN distributes insignia and metals based on standard criteria that, most likely, the majority of officers do possess. Thus, given the absence of bonuses and the equal distribution of metals across the majority of officers, few factors are in place to motivate officers to work productively.

*f. Early Promotions*

Early promotion is a procedure that exists in the USM and acts as an incentive. The HN does not use early promotions; rather, ordinance 167/A/2010, issued by the presidency in 2010, defines the fixed length of time that each officer, from O1 to O6, has to spend in each pay grade. Therefore, no other potential incentives to motivate officers exists.

*g. Retirement Schemes*

Military retirement schemes differ among nations. In the United States, the minimum time required to get a pension is twenty years. If a uniformed individual decides to leave the military before that length of time, he gets no retirement pay. In 2010 the Hellenic parliament approved many tough measures for the public sector, among which is a new retirement scheme for the HN. This scheme demands thirty-five years of actual service for a uniformed individual to qualify for a pension. Earlier separation from

the military means he will receive no pension until the age of sixty. Prior to 2010, some military personnel could retire after sixteen years of service (especially those in the helicopter, underwater demolition, and submarine communities), and deck officers after twenty-five years of service, and receive retirement pay.

Such a change, even though it was inevitable for the entire public sector, had a significant impact on both the uniformed personnel of the HAF and those individuals who were considering reenlistment. The military environment is risky by nature, and an earlier retirement plan attracted very capable individuals. Its abolishment has two potential outcomes. Firstly, it might negatively affect the number of high quality recruits. Second, military personnel whose “goal contests are associated with differing degrees of need satisfaction”<sup>9</sup> and have a need satisfaction (an element that contributes to motivation) that includes early separation and retirement pay, might be disappointed and, as a consequence, exhibit low levels of productivity and performance. Essentially, the new retirement system might affect motivation in the long run.

#### ***h. Military: Greedy Institutions***

“Military organizations are ‘greedy institutions’ because they require a lot from their personnel: during active duty, personnel are on a permanent, 24-hour call with rather idiosyncratic working shifts.”<sup>10</sup> Shattuck (NPS professor, 2011), states that, “concerning the Navy, even though the Navy standard workweek reflects a desired standard, it does not reflect what is actually being done at sea times.”<sup>11</sup>

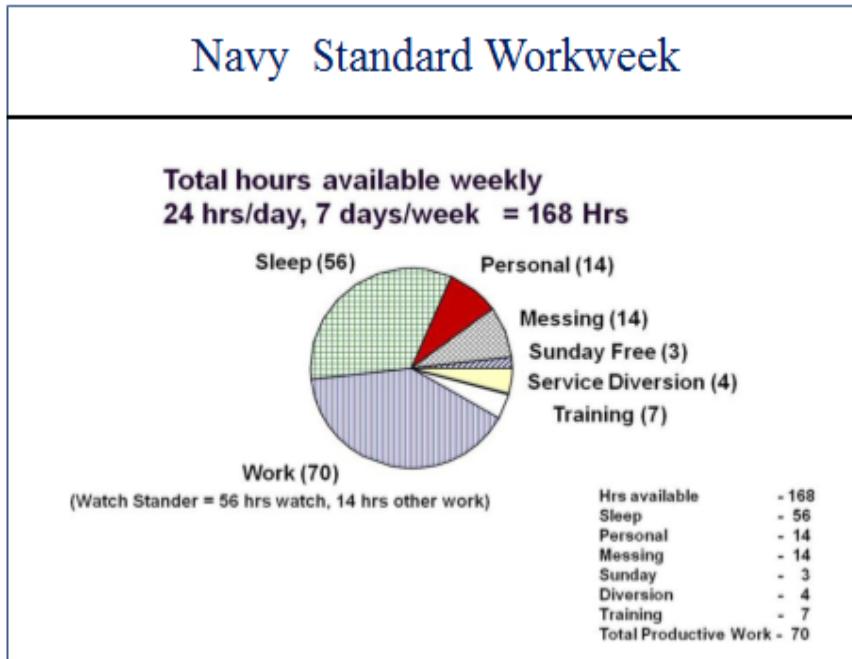


Figure 3. At sea Navy standard workweek (From <sup>11</sup>)

In other words, there are more working hours a week than Figure 3 reflects. Furthermore, military personnel can be deployed in remote areas for extended periods of time with short notice. Finally, Soeters, Winslow, and Weibull write about military personnel that “their leave might be a subject to cancellation (Druckman et al., 1997).”<sup>10</sup> In any case, military personnel cannot decline a deployment or avoid the circadian rhythms of assignments. Furthermore, they do not receive extra compensation when working more than the normal working hours.

HN does not differ from other military organizations and their policies requiring 24-hour call and circadian rhythms of assignments. HN ships, a few operational ground stations, and many other services are aligned with these working conditions which represent a portion of the overall HN culture. As McShane and Von Glinow write, “strong culture increases organizational performance only when the cultural content is appropriate for the organization’s environment.”<sup>11</sup>

*i. Fixed Working Conditions*

Military personnel cannot bargain for working conditions when it comes to infrastructure. The human–systems integration (HSI) concept includes actions taken in the early stages of projects and systems acquisition (e.g., acquisition of ships, platforms, ground facilities) that satisfy customer needs throughout the system’s lifecycle. HSI influences the actions and behavior of all participants (designers, customers, users, repairmen,) who are engaged in the system. Domains that play an important role in HSI are manpower, personnel, training, safety, occupational health, survivability, and habitability, in which individuals are at the core. Working conditions are discussed in this process not only to embrace the domains mentioned above, but also to secure their appropriateness. They are approved by the ministry of defense (if their cost does not exceed the budget available for the project) and implemented during system construction. At that point, nothing can change. Essentially, both military and civilian personnel who work with such an infrastructure are obliged to do their best, given the existing conditions.

There is a potential of course, in the case of inappropriate working conditions, to ask and achieve small improvements, but that takes much time and is achieved through difficult bureaucratic procedures and budgeting constraints. These standards obligate HN officers to exhibit high levels of performance under specific working conditions without being asked for input prior to acquisition and subsequently have no authority to invoke change. Striking, one of the rights that workers have, not only in civilian organizations but also in the public sector, is an unknown word in the vocabulary of military organizations around the globe.

*j. Discharges*

Unlike civilian organizations, the military cannot easily discharge poor uniformed performers, due to obligated service and return on investment. Unproductive civilian worker discharge is difficult because of the tough bureaucratic personnel procedures that need to be followed and the labor unions, within military environments, who protect and complicate the situation. Stites, (USN Captain), writes of labor unions:

“in democratic societies, the protection of individual rights is the cornerstone of government. Each institution/union in the society must protect individual rights to the maximum extent possible.”<sup>12</sup>

Implications appear in cases like these that are closely related to the job performance of uniformed personnel and, especially, team leaders. Dew, (NPS professor , 2011), states that “people that surround the star worker are those who implement the ideas and make the difference, after all.” Star workers are those individuals who are very capable/top performers or those with advanced education. The people who surround the star worker are the group of assistants who represent the team. Thus, if those uniformed or civilian personnel surrounding the star worker are poor performers and cannot be easily discharged, the team will not likely exhibit high productivity.

The immediate outcome of a team’s poor performance has a strong effect on the leader, even though he might be a very capable person. Therefore, when an officer has been assigned to lead a team whose nonfunctional members cannot easily be discharged, he needs to be simultaneously an extremely high performer and an effective leader so as to lead his team to success even when the roster lacks capable personnel.

#### *k. Multi-Cultural Organizations*

The HAF consists of a large number of sub-organizations, including the three major branches—Army, Navy and Air force—as shown in Figure 4.

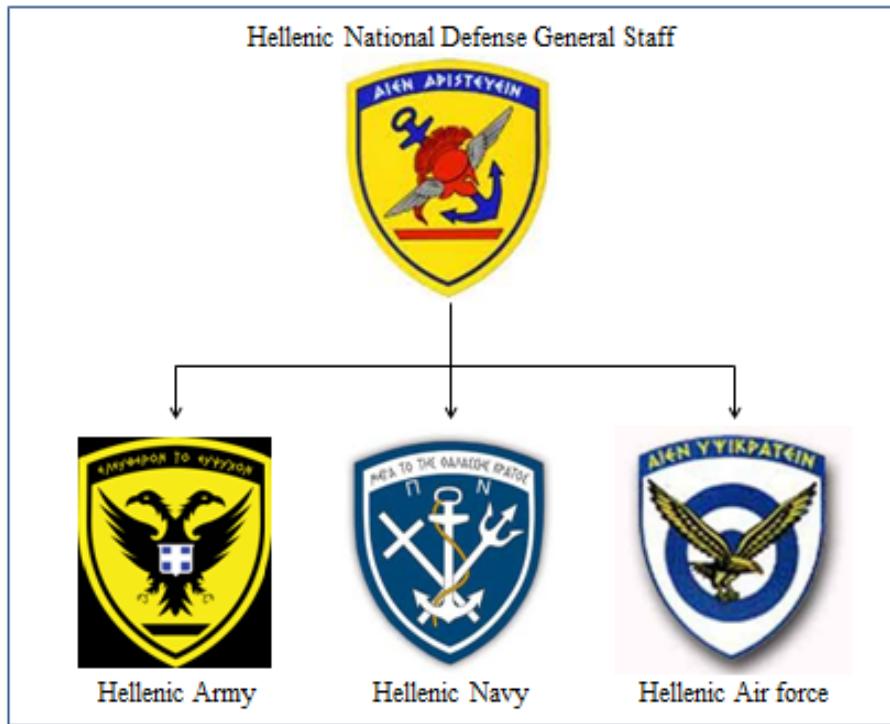


Figure 4. Structure of the Hellenic Armed Forces

As the NRC states of the USM, “each one of the branches strives to maximize its own role in the larger organization.”<sup>2</sup> This is true in the HAF as well. Furthermore, each branch has its own philosophy and concepts about war operations. Thus, despite the fundamental differences and cultures that separate the sub-organizations, today’s complex war operations force them to cooperate so as to achieve their goals. In other words, as Jackson and Holvino write, “in a multicultural organization, conflict-management skills need to include synergistic problem solving, value clarification, consensus building, and other collaborative strategies for managing differences.”<sup>13</sup> Their words reflect why officers with different cultures (even in the HN) should be flexible and possess a high level of communication and interaction skills. These are indeed very significant elements of job performance and effective cooperation.

#### *l. Placements*

Decision makers in military organizations usually place officers in billets whose job descriptions fit their skills. Extended placements like these occur in the middle

pay grades where officers have specific skills and are simultaneously experienced and relatively young, and therefore constitute the most productive part of the military workforce. However, due to the huge diversity of skills, middle-pay-grade officers might be effective in middle-pay-grade billets, but not all of them are qualified to be promoted as top-rank officers and, thus, superior leaders. The highest layers of the pay-grade pyramid call for a combination of effective leadership and advanced job performance. Promotion boards are responsible to separate extremely capable officers, who possess the skills to become top-rank officers, from average ones.

#### *m. History, Traditions*

The characteristic that clearly separates the HN from other organizations is its own distinguished history/traditions. Two prominent examples illuminate the bright route that the navy has followed throughout the centuries.

(1) Naval Battle of Salamis, 480 BC. The famous sea battle of Salamis took place in the straits of Salamis Island on the 22nd of September, 480 B.C. An alliance of Greek city-states that owned a fleet of 366 ships, commanded by an extremely capable leader named Themistokles (a famous politician and general), destroyed the fleet of the Persian Empire, consisting of 1207 ships. That defeat forced Xerxes and his troops to retreat once and for all. This sea battle is actually a milestone of ancient history, since it is believed that a Persian victory would have ended the development of both ancient Greece and Western Civilization. Strauss writes of the Battle of Salamis: “The world had never seen a battle like it. A channel only a mile wide held the fighting men of the three continents of the Old World: Africa, Asia and Europe.”<sup>14</sup> He declares the battle as the milestone in the salvation of Greece and Western Civilization.

(2) HS *Adrias*, 1943. The second example took place in October 1943, when the escort destroyer *Adrias* survived a mine explosion in the Aegean Sea because of remarkable damage-control efforts.

Commander Ioannis N. Toumbas grounded the ship in shallow waters off the Turkish coast so as to repair it to the extent possible. He later pulled the *Adrias* off in order to seek shelter in a more secluded cove. A month

later, *Adrias* sailed stern-first under escort from three British motor gunboats to Limassol, Cyprus, and then on to Alexandria. It was too badly damaged to be worth repair, but the crew was saved and the RHN demonstrated its bravery and seamanship.<sup>15</sup>

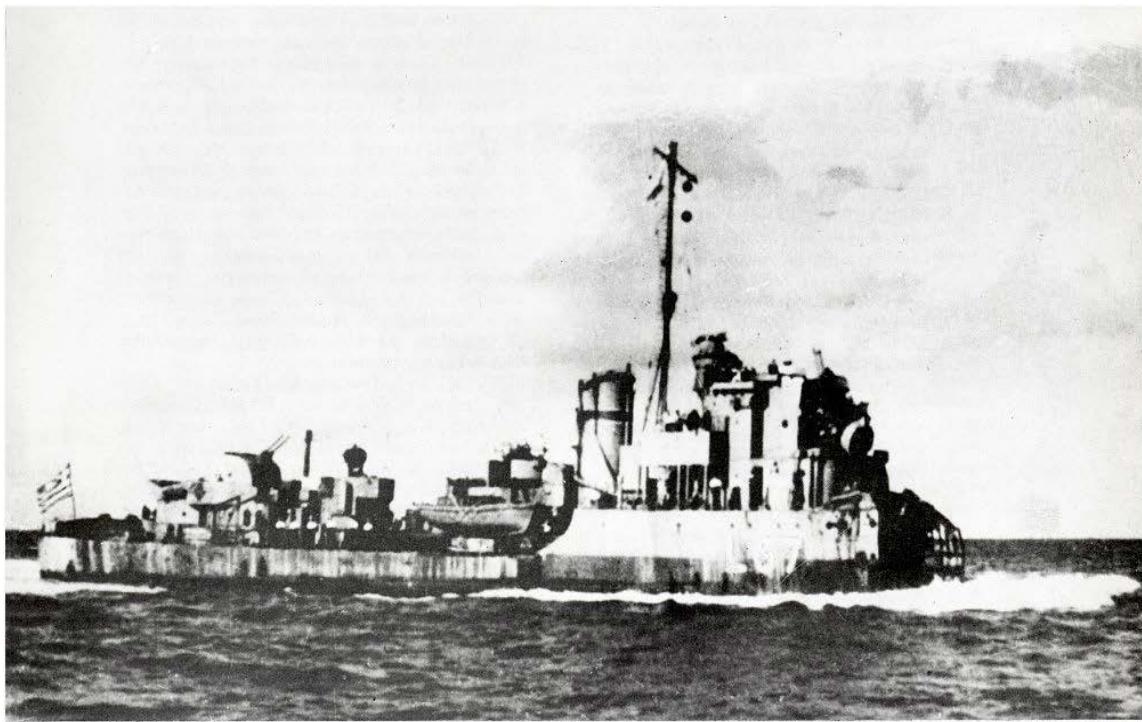


Figure 5. Escort destroyer *Adrias* sailing back to Alexandria

These examples reflect how high-quality personnel under strong leadership can accomplish the impossible. The sea battle of Salamis and the trip of the seriously damaged *Adrias* back to Alexandria signal that strong personality traits, principles, and beliefs should always be the guide in selecting officers to achieve the goals of the HN as an organization. That has a special meaning nowadays, when Hellas suffers an unprecedented financial crisis that significantly reduces available resources. In other words, officers should exceed their potentials by exhibiting advanced levels of performance to maintain the high HN standards of history and tradition.

### **3. Job-Design Theories and Dimensions Applied to Military Organizations**

An analysis of the characteristics that clearly separate military from civilian organizations leads to those theories of job design that best fits military concepts. Potter presents an analysis of job design that builds on assumptions and approaches in social science, including the dimensions of ontology, epistemology, and human nature.

#### **a. *Ontological Dimensions***

Within the ontological dimension are two opposite trends concerning the explanation of job design. The first comes from the interpretivist point of view, defining job design “as being real only in the mind of the participant. In other words, job design is understood from the way that the worker has come to know his job. The design of the job is constructed through the participant’s perspective.”<sup>16</sup> The second trend traces back to the functionalist perspective, which sees “job design as the set of written descriptions of actions, methods and techniques that compose the requirements of a particular job.”<sup>16</sup>

#### **b. *Epistemological Dimensions***

Within epistemology, again, interpretivists say that the “participant has come to know his or her job through their own unique experiences”<sup>16</sup> whereas a functionalist assumes that “job design can be known and understood removed from the individual. For example, the knowledge can be transferred in complete form from one person to another person through the use of written procedures.”<sup>16</sup>

#### **c. *Human-Nature Dimension***

Within the dimension of human nature, the voluntaristic and deterministic trends approach job design from opposite directions. However, their approaches are somewhat difficult to imagine. Job design, from the organization’s perspective, designates how individuals “should go about accomplishing their tasks, which implies the worker is constrained by the job design.”<sup>16</sup> A “voluntaristic view suggests that individuals are free to act in whatever way they wish in any situation”<sup>16</sup>, whereas a “deterministic view holds that people are constrained by the social situations of everyday

life and thus are not free to act.”<sup>16</sup> Indeed, military personnel hold a distinguished place in society, they are identified by their uniforms, anyone can recognize them and, thus, they are obliged in every moment of their lives to set a good example of military personnel. They therefore operate in a deterministic environment within the society.

The trend of functionalists in the ontological dimension views “job design as the set of written descriptions of actions, methods and techniques that compose the requirements of a particular job.”<sup>16</sup> In the epistemological dimension, “knowledge can be transferred in complete form from one person to another person through the use of written procedures.”<sup>16</sup> In the deterministic view of human nature, “people are constrained by the social situations of everyday life and thus are not free to act.”<sup>16</sup> This describes job design from the military’s point of view, which sets the frame of regulations and actions of all uniformed individuals.

#### **4. Defining Job Performance within Military Organization.**

As stated, there are a number of definitions of job performance. Without defining the nature of an organization, Campbell describes job performance from a psychological perspective as an individual-level variable. In other words, individual performance is simply the frame of behavior under which men perform tasks. Campbell also points out that performance can take the form of a mentally unobservable ability. Decision making reflects that mental ability. Further developing these definitions, Mathis and Jackson present their findings about what constitutes a good individual (job) performance within the sector of human-resource management. Elements such as quantity and quality of work that are related to the meanings of effectiveness and efficiency, compatibility with others, which essentially leads to good communication skills, presence at work (including the personality and appearance each individual sends out at work—they both play a very important role within military organizations), length of service (which can expand experience) and, finally, flexibility in terms of figuring out ways to maximize profits, all constitute a set of factors that explain an advanced level of performance. Mathis and Jackson analyze “what constitutes good job performance on a job.”<sup>19</sup> These elements are presented in Figure 6.

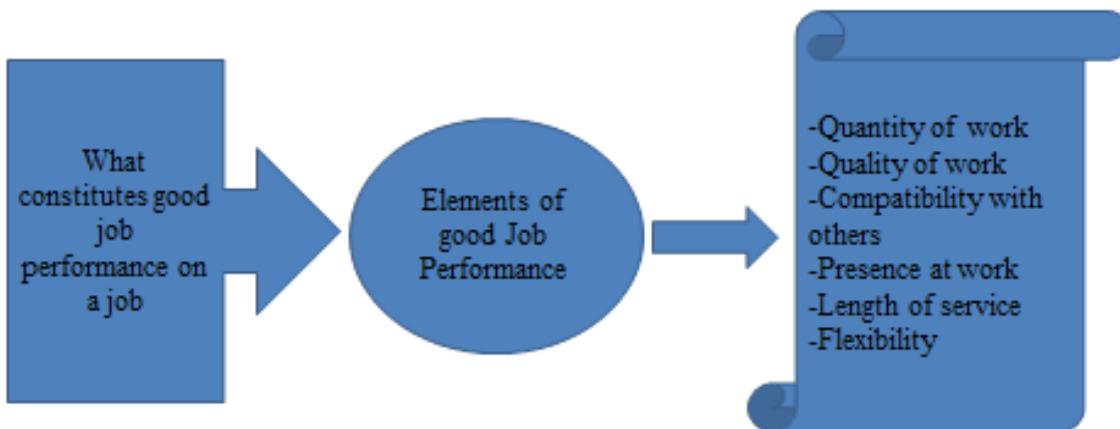


Figure 6. Job performance (After <sup>19</sup>)

However, given the nature and constraints that flow from the characteristics and distinguished job design of military environments, job performance within military environments is a **flexible** behavior that uniformed individuals should employ against any enemy that threatens the nation's interests. Their behavior may be either aggressive or defensive, depending on the nature of the threat. Moreover, uniformed individuals should be willing to expose their lives to danger whenever the nation's interests so demand.

Job performance is the most significant criterion that defines the overall success of an organization. A number of definitions point out that job performance is an individual-level variable, from a psychological perspective, and a mental, unobservable ability (such as precise decision making). The same words are used to express the ability of personnel to accomplish tasks in both civilian, profit making, and military, nonprofit organizations. However, military organizations across the globe, including the HN, differ from their civilian counterparts due to a number of specific characteristics. Their unique mission to kill and destroy enemies, their fixed budget and resources, the mixed set of personnel (uniformed and non-uniformed) that characterize the workforce, the fixed rank and pay structures, the lack of early promotions to indicate high performance (for the HN), fixed retirement schemes, working hours that exceed normal patterns, fixed working conditions concerning infrastructure, barriers to discharging uniformed and civilian poor performers, the existence of multiple sub-organizations/branches, specific

placement patterns and, finally, a distinguished history and long traditions frame the military's unique job design and create an overall culture which states that "military organization with its 'top to bottom' control, is viewed as anti-individualistic and in conflict with basic democratic principles."<sup>12</sup> Figure 7 graphically presents those characteristics. Nevertheless, despite a number of constraints within military organizations, their uniformed and civilian personnel should accomplish tasks simply because "when a democratic state experiences a threat to its primary vital interest, survival, the military institution is accepted as necessary to insure state preservation."<sup>12</sup>

To achieve that goal, high-quality personnel must be included in the workforce of any military organization. Job performance dictates that these personnel exhibit flexible behavior and readiness to put their lives in danger whenever the nation demands.



Figure 7. Specific characteristics of Military Organizations

### C. DEFINING JOB PERFORMANCE FROM THE HUMAN PERSPECTIVE

Given the specific characteristics that separate military organizations from civilian, military job performance has been defined as that behavior which military personnel should employ to achieve the goals of the organization. Beyond what the military desires, job performance should also be analyzed from the individual's perspective. All definitions present job performance as a behavior and, therefore, human traits such as experience and abilities shape each individual's behavior in both the working environment and his life.

Mitchell, based on the literature of Porter and Lawler, (1968) and Campbell and Pritchard (1976), writes:

Performance is caused by at least four and maybe more factors. In order to do well, one must know what is required (role expectations/perceptions), have the ability to do what is required, be motivated, and work in an environment in which intended actions can be translated into behavior.<sup>20</sup>

These factors shape the MARS (motivation, abilities, role perceptions, and situational factors) model, as shown in Figure 8. However, motivation may be irrelevant to job performance in the MARS model. An example is when ability dominates motivation. Intellectual desire to achieve high scores at school may be more important than the obligation to study for many hours. Dunnette (January 1973) notes that “ability differences still are empirically the most important determiners of differences in job performance”<sup>21</sup> and adds that “the degree of departure of job performance variance from what would be predicted by ability differences may provide clues about the degree of involvement of motivational variables.”<sup>21</sup>

The specific characteristics of military organizations call for motivation and ability to be complements and not substitutes, because they both play a significant role in the successful accomplishment of tasks and goals. Another example in military environments is when technological means control the successful accomplishment of tasks, regardless of the level of an officer's performance. In present times, advanced technology informs the armed forces, reducing the amount of effort an officer puts into achieving a task. Thus, if the successful accomplishment of a task depends mainly on

technology, the exertion an officer contributes is probably irrelevant to the overall performance of the system–officer technological means. However, the military's distinguished mission and the power that comes from advanced technology dictates technology's wise use. Therefore, officers' job performances should be built on strong personalities.

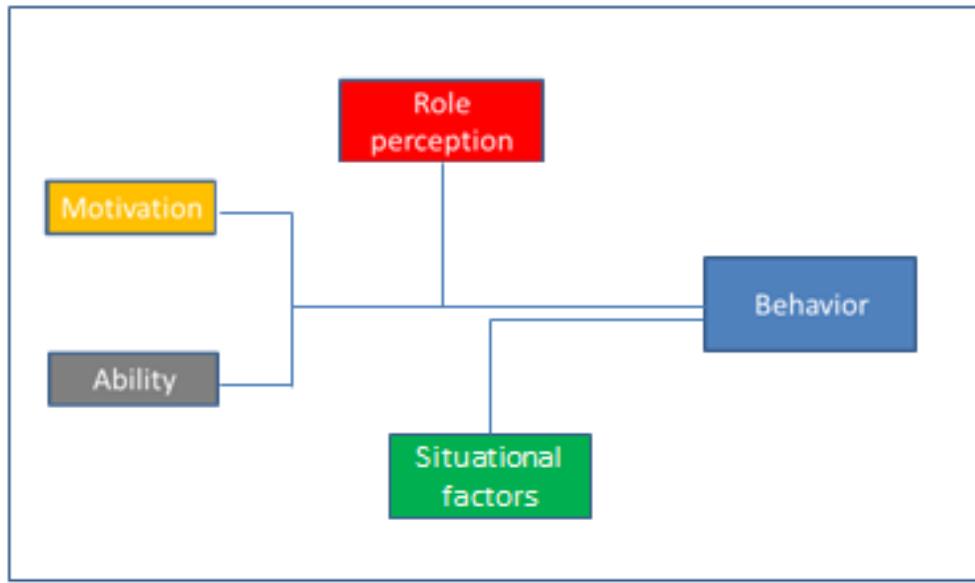


Figure 8. The MARS model

Consequently, the MARS model may be modified twice. The added human trait of experience and the traits of ability and motivation (which are already integral parts of the model) may initially reshape the model. Personality makes up the model's final shape. These modifications are due to human traits that illustrate significant aspects of human behavior.

### 1. Experience

Experience can be approached from different directions. Given the standardization of an officer's training, “physical” experience is one of these aspects which best fit the military environment. Popper and Eccles write, “Physical experience occurs whenever an object or environment changes.”<sup>22</sup> In other words, an individual acquires physical experience when he observes various situations throughout an extended

period. Dewey adds, “We live from birth to death in a world of persons and things which in large measure is what it is because of what has been done and transmitted from previous human activities.”<sup>23</sup> That is, a number of events in the real world shape an individual’s experience. The world changes every day and generates the continuity of experience, and experience functions as feedback. Given the successive events of previous situations and their results, individuals can modify the quality of their actions in future situations, based on transactions that occur between persons in the environment. People, objects and events comprise the environment. Furthermore, Dewey says that environment is any condition that interacts with an individual’s needs, purposes and goals. However, experience can broaden one’s mind or narrow it. According to de Nicolas,

...as an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world, but in a different part or aspect of one and the same world. What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situation which follow. The process goes on as long as life and learning continue.<sup>24</sup>

The author, in this case, imports the meaning of learning, which makes experience a useful tool. Learning, in terms of education, acts as a complement to experience, and not a substitute. Thus, experience should be analyzed under two conditions. The first condition is the existence of experience itself. The second condition is interaction between experience and education.

#### *a. Experience without Education*

In the absence of education, it is likely that experience narrows the range of human minds. This is natural. Individuals base their actions on old theories they know and find themselves reluctant to implement new ones. Without implementing the new ideas that education offers, individuals establish obstacles to their experience’s further growth. Especially for those who possess key positions within an organization, it is likely that they will prevent educated individuals who willing to put in extra effort from implementing new ideas that benefit the organization. “Experienced” people know how

the system “works,” they have dealt with a number of events in the past and, thus, they too often consider new ideas excessive luxuries. These are the old-fashioned minds that are afraid of potential changes. Many of them can be met within military environments.

Let’s not forget that military organizations do not have competitors, and they do not care about new ideas and processes related to profit making. Thus, narrow-minded people do not undertake responsibilities equivalent to the magnitude of their key positions, and they try to defend their own obsolete ideas. Finally, they care most about themselves and their interests rather than the overall progress of the organization for which they work.

***b. Experience Combined with Education***

On the other hand, education helps individuals to be opened minded. Dewey “interprets education as the scientific method by means of which man studies the world, acquires cumulatively knowledge of meanings and values, these outcomes, however, being data for critical study and intelligent living.”<sup>23</sup> These ideas promote an individual’s experience in the form of “intelligent living”. Therefore, people become more flexible. They approach situations from different directions and distinguish their roles and set priorities in order to successfully achieve their goals and the goals of the organization. These people are needed in the military environment in order to implement new ideas, successful or not. Even though the military does not seek profits, in terms of money, its distinct mission demands the acceptance and implementation of new ideas that will lead to a competitive advantage over the capabilities of a potential enemy.

Experience is a crucial factor that may determine positively or negatively the overall outcome of an action in any situation. It is likely that neither experience nor education can stand by itself. Of course, many other characteristics play an important role in how individuals interact with the environment in which they live. However, the appropriate combination of experience and education helps an individual to achieve “intelligent living.” Military organizations need their personnel (especially their officers, who are the future leaders) to possess both experience and a certain level of education.

Only then can officers be opened minded and accept and implement new ideas. That is the way to secure a competitive advantage over an enemy's capabilities.

## **2. Abilities**

According to McShane and Von Glinow, ability is one of the “four factors which directly influence voluntarily individual behavior and performance.”<sup>1</sup> It is the correlation between ability and performance that leads every organization, civilian or military, to seek capable people. Besides, advanced ability helps employees to achieve their goals efficiently.

Nicholls describes two different conceptions of ability. Their common notion is that effort and learning help improve task mastery. Furthermore, once task mastery has been developed, it is not normally lost. In other words, Nicholls claims that ability is divided into natural talents that allow individuals to learn the material they need to successfully accomplish their goals. He concludes that learning is subject to time (effort) and learned capabilities (educational background, skills).

### ***a. First Conception of Ability***

The first conception combines a task’s level of difficulty and each individual’s self-judgment about his ability. These elements help individuals realize their perceived mastery and level of knowledge. An example of the first conception is when individuals feel they have learned the necessary material well. They become automatically more competent and they consider a task difficult only when they believe they will fail. Thus, concerning self-confidence, the more difficult the task, the higher the level of ability a potential success denotes.

### ***b. Second Conception of Ability***

The second conception correlates ability with capacity. In this case, time is the dependent variable. The less time someone needs to learn the material (compared to another person), the higher capacity he possesses, and vice versa.

Given the two conceptions, ability is divided into three components: general ability (or general intelligence), perceptual speed, and psychomotor ability. Ackerman writes of general ability that it “represents a broad construct that underlies nonspecific information.”<sup>26</sup> General ability corresponds to the first conception. Ackerman considers the main concept in perceptual speed ability to be the speed of consistent encoding and symbol comparison—that is, how fast one creates memory codes for a word, or an object, or anything else, in order to remember it. Finally, he says psychomotor ability represents individual differences concerning the speed and accuracy of responses, with little or no cognitive-processing demands. In other words, he underlines the importance of human response when specific knowledge is not needed. Perceptual speed and psychomotor ability correspond to the second conception, and all three components are related to individual performance, as explained below.

Whenever there is a task to be accomplished, a few instructions and procedures have to be established. There are three phases concerning the skill-acquisition needed to accomplish a task (these skills relate to learning the instructions and procedures of the task). Each one of these phases corresponds to the three components. Phase one corresponds to general ability, phase two corresponds to perceptual-speed ability and phase three corresponds to psychomotor ability. The three panels that include the three phases on the “x” axis and the performance level on the “y” axis, indicating the ability function of each component are shown in Figure 9.

The top panel shows that general ability, the phase encompassing the establishment of instructions and procedures of a task (which are almost unknown and tests the individual’s perceived mastery and knowledge) will help an individual to perform well enough while acquiring needed skills (learning instructions/procedures). The panel in the middle refers to a situation where the establishment of the instructions/procedures is set. One who possesses perceptual-speed ability (phase two) will adapt the instructions/procedures to the task in a short time (adaptation also implies acquisition of skills). Thus, this person will exhibit high levels of performance (Phase two is in line with the top of the bell curve). Finally, the bottom panel illustrates phase three.

Individuals who have been engaged with and practiced a task long enough do not need speed ability anymore. Therefore, based on psychomotor ability, they exhibit a lower level of performance.

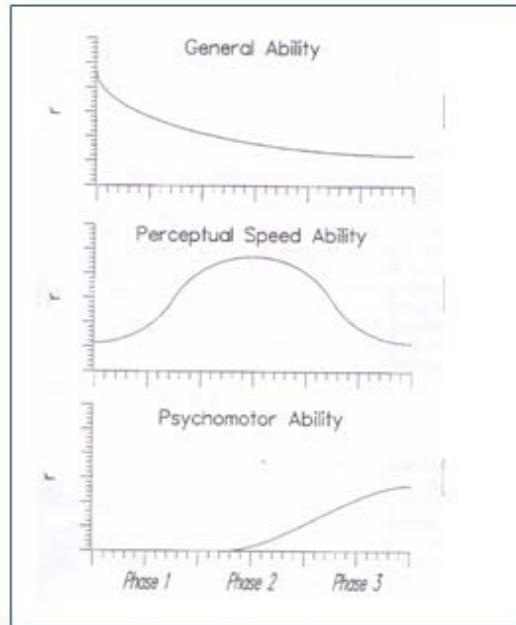


Figure 9. Performance-vs.-ability function (From <sup>26</sup>)

In phase three, we observe a minor difference of performance levels (between panels two and three). That means the differences between fast and slow learners are small in this particular phase.

Ability is a human factor that reflects the natural talents and capabilities within an individual in learning, as quickly as possible, what is needed to accomplish tasks. Serious attention to ability should be paid within military environments. High-pay grades demand officers who should be able to make serious decisions (even concerning the lives of their subordinates). Thus, given the knowledge they should have for each task, they must possess both general and perceptual speed ability in order to take an initial action as the task begins. Then, having understood how the situation progressed, they have to make other right decisions in almost no time.

Both these deeds are indicators of high levels of performance. Therefore, higher standards of ability should be paramount while an officer climbs up the chain of command.

The analysis of experience and ability suggests a modified MARS model, as shown in Figure. The reformed model shows the interaction of experience with the elements of role perception, ability (as an integral part of behavior) and situational factors. Overall, the new model reflects the meaning of experience. There are additional reasons for the close relationship of experience with the other factors of the reformed model.

- Experience is very important for role perception. If combined with education, it can help individuals to understand clearly the assigned task, set priorities, and designate the appropriate behavior to achieve goals. Thus, they perceive their roles in such a way as to benefit the organization. If not combined with education, they will most likely perceive their role from their own point of view, in any situation. In other words, they will take the set of actions that benefits only themselves.
- McShane and Von Glinow define ability as “the natural aptitudes and learned capabilities required to successfully complete a task.”<sup>1</sup> Therefore, the combination of experience, which upgrades the natural aptitude of capturing images/events quickly, and education (the outcome of learning capabilities) perfectly match this definition.
- Situational factors are those that change frequently. An example would be the roster of personnel in a job or the available budget. Especially for military organizations, the working environment changes frequently due to transfers and principles under which every commander wants personnel to work. Unlike those who possess only experience, individuals with both experience and education are more likely to perform in a way that will benefit the entire organization, under any circumstances.

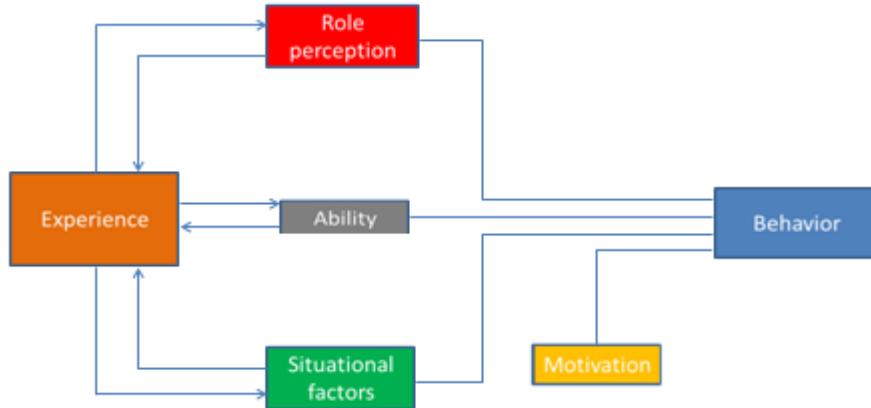


Figure 10. Modified MARS model

The modified model does not present any connection between experience and motivation. Murray writes:

Motivation is distinguished from other factors that also influence behavior, such as the past experience of the person, his physical capabilities, and the environmental situation in which he finds himself, although these other factors may influence motivation.<sup>27</sup>

Dunn and Stephens add that motive lives within an individual's character (internal drive) and guides the set of actions. They note that after achievement of the goal, motive is no longer operative. Thus, motivation, as an internal drive, lives within humans despite the level of experience they possess.

### 3. Motivation

Much discussion has been made about motivation. Is it an internal drive of individuals or a process/set of actions that managers or supervisors should take in order to stimulate the workforce to perform as best as it can? According to Connor, the second option is a myth that turns out to be a lie. He points out that people motivate themselves. Yet, he says, managers and supervisors should direct their actions into creating a working environment that will stimulate employees to motivate themselves. Mitchell writes that motivation may be the amount of effort that an individual is willing to put in so as to perform well any assigned task. Additionally, he mentions that social scientists perceive motivation as "psychological processes that cause the arousal, direction, and persistence

of behavior.”<sup>20</sup> Regardless of the disagreement over potential aspects of defining motivation, Mitchell mentions four core values that best characterize it.

- Motivation traditionally has been cast as an individual phenomenon. Each individual is unique and all of the major motivational theories allow in one way or another for this uniqueness to be demonstrated.<sup>20</sup>

(For example, different people have different needs, expectations, values, attitudes, reinforcement histories, and goals.)

- Motivation usually is described as intentional. That is, motivation supposedly is under the employee's control. Most behaviors that are seen as influenced by motivation (e.g., effort on the job) typically are viewed as actions the individual has chosen to do.<sup>20</sup>
- Motivation is multifaceted. The two factors of greatest importance have been the arousal (activation, energizers) and direction (choice) of behavior.<sup>20</sup>
- The purpose of motivational theories is to predict behavior. Motivation is concerned with action and the internal and external forces that influence one's choice of action. Motivation is not the behavior itself, and it is not performance. The behavior is the criterion--that which is chosen. And in some cases the chosen action will be a good reflection of performance.<sup>20</sup>

Given the four core values, a more detailed definition can be expressed. ‘Motivation becomes the herald to specific behaviors that an individual chooses in order to accomplish assigned tasks. Although there are many theories which analyze different reasons, all their concepts focus on an individual’s intentional choices to explain motivation.’

Since motivation surrounds an individual’s intention, it is good to know the cause that shapes behaviors. An individual’s primary needs and personal goals—the directed internal forces—are the answer. Primary needs send signals to the human brain in order to correct potential deficiencies or to maintain an internal equilibrium. Personal goals and self-directed internal forces are very similar to primary needs, but now emotions have replaced transmitted signals. In the 1940s, Maslow developed the needs-hierarchy theory.

Stewart and Stewart describe it as a five-layer pyramid with a bottom-to-the-top directional flow. The description of Maslow's needs-hierarchy theory is shown in Figure 11.

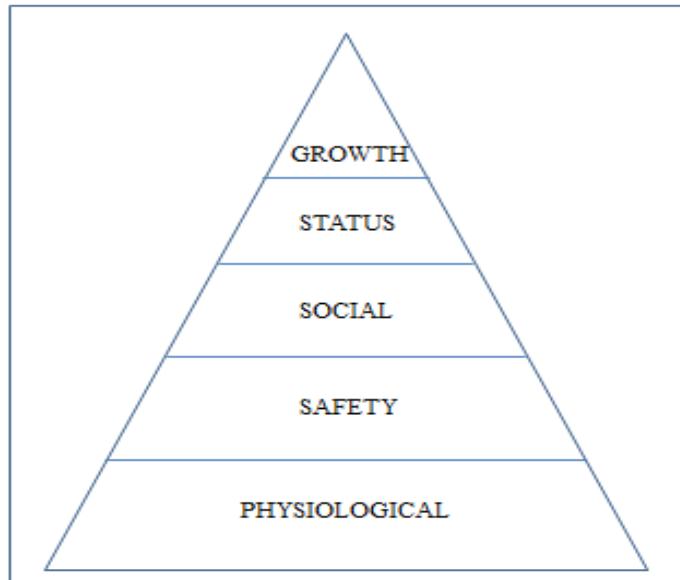


Figure 11. Maslow's needs hierarchy

The bottom layer includes physiological needs such as food, water, sleep, shelter, etc. The next layer includes safety needs, such as the need to be protected from a potential threat. The third layer is related to social needs, that is, the need for companionship with people who surround us. The fourth layer includes status needs. These needs include self-esteem and social esteem. The former comes after the accomplishment of personal achievements. The latter is related to social recognition and respect because of the positive signals we believe our personality sends out. Status needs are followed by the top layer of the pyramid, which includes the need for growth. Growth is the specific design to meet new challenges and realize our potential. McShane and Von Glinow state that

...according to Maslow, we are motivated simultaneously by several needs, but the strongest source is the lowest unsatisfied need at the time. As the person satisfies a lower level need, the next higher need in the hierarchy becomes the primary motivator and remains so even if never

satisfied. Psychological needs are initially the most important and people are motivated to satisfy them first.<sup>1</sup>

The first four levels, from bottom to top, are also known as *deficiency* needs. They start once deficiencies appear, and they vanish when deficiencies are corrected. The growth need is always activated because, under normal circumstances, individuals seek their constant personal development.

In addition to Abraham Maslow's needs-hierarchy theory, a recently developed theory shows that emotions, in terms of incentives, contribute to personal motivation. That theory, known as four-drive theory, was developed by Lawrence and Nohria. Four-drive theory suggests that "people are guided by four basic emotional needs, or drives, that are the product of our common evolutionary heritage."<sup>31</sup> These are:

- The drive to acquire (obtain scarce goods, including intangibles such as social status)
- The drive to bond (either with individuals or groups)
- The drive to comprehend (satisfy our curiosity and master the world around us)
- The drive to defend (to be secure against external threats)

These four drives/needs may be correlated to or substituted for one another. They also interpret the way people act in their daily lives. However, four-drive theory stipulates that when a person wants to be fully motivated, this person needs to satisfy all four of them.

#### **4. Personality**

Personality is an individual characteristic that has many aspects. However, its core, in simple words, is about what we are as human beings and how we interact with other people. Rogers notes that personality originates from the Latin word *persona* and "persona" means a mask that is

...worn by every soul on its journey through the world, through human life. It is the medium through which we are known to other human beings

and communicate with them. We may say that it is a kind of shell, the external and superficial part of us.<sup>32</sup>

Because each one of us wears his own mask throughout his entire life, the mask takes the form of an everlasting pattern of emotions, thoughts, and manners, based on which we live and interact with other people within society. A human's personality begins at birth. Thus, from nature's point of view, personality is the genes that are inherited by the parents. While we are growing up, nurture starts to complement nature.

McShane and Von Glinow explain nurture as "a person's socialization, life experience, and other forms of interaction with the environment."<sup>1</sup> They also say "the stability of an individual's personality increases up to at least age of 30 and possibly to age 50, indicating that some personality development and change occurs when people are young."<sup>1</sup> As people grow older, their personality is enhanced and altered by every single situation and event that happens in their lives. Although there is a huge number of these situations and events, the most important, from birth to adolescence, are family background, which gives initial principles to a child, and life at school (interaction with age-mates imparts additional principles). When becoming adults, decisions about what job to do and about what kind of family to create contribute further to the evolution of personality. Finally, after individuals have completed their lifecycle, they become responsible for teaching their children principles on which they should build their own personalities. This cycle explains the fact that, when people grow up, they form solid life concepts and their personality becomes stable. However, there is a controversy whether nature or nurture contributes more to personality's final shape.

The identification of the structure of personality has been studied for centuries. The Greek philosopher Aristotle determined that personality was the sum of several categories. However, in recent years, the five-factor model of personality, shown in Figure 11, is the model most commonly accepted by personality researchers. Judge and Bono analyze the model as follows:

The Big Five traits are broad personality constructs that are manifested in more specific traits. Factor 1, Extraversion, represents the tendency to be outgoing, assertive, active, and excitement seeking. Individuals scoring high on Extraversion are strongly predisposed to the experience of positive

emotions (Watson & Clark, 1997). Factor 2, Agreeableness, consists of tendencies to be kind, gentle, trusting and trustworthy, and warm. Factor 3, Conscientiousness, is indicated by two major facets: achievement and dependability. Conscientiousness is the trait from the five-factor model that best correlates with job performance (Barrick & Mount, 1991). Factor 4, Emotional Adjustment, is often labeled by its opposite, Neuroticism, which is the tendency to be anxious, fearful, depressed, and moody. Emotional Adjustment is the principal Big Five trait that leads to life satisfaction and freedom from depression and other mental ailments (McCrae & Costa, 1991). Finally, Factor 5, Openness to Experience (sometimes labeled Intellectance), represents the tendency to be creative, imaginative, perceptive, and thoughtful. Openness to Experience is the only Big Five trait to display appreciable correlations with intelligence.<sup>33</sup>

The dimensions of the five-factor model, tendencies that emerge from each dimension and the overall effect on an individual's personality are shown in Figure 12.

Five Dimensions	Tendencies	Overall Outcome
Extroversion	Outgoing, assertive, Active and excitement seeking	Low scores = Introverts, quite comfortable being alone
Agreeableness	Kind, Gentle, Trusting, Trustworthy and Warm	Low scores = uncooperative
Conscientiousness	Achievement Dependability	<b>Indicates job performance.</b> High scores = will to achieve. Low scores = disorganized and irresponsible
Neuroticism	Anxious, Fearful, Depressed and Moody	Low scores = Poised, Secured and Calm
Openness to experience	Creative, Imaginative, Perceptive and Thoughtful	<b>Indicates correlation with intelligence</b> Low scores = resistant to change and less open to new ideas

Figure 12. Five-factor model of personality (After <sup>1</sup>)

In military environments, evaluations of officers should be based on the content of the five-factor model, because each panel of the outcome column indicates an appropriate personality that complements the successful accomplishment of tasks.

After the analysis of personal traits such as experience, ability (already an integral part of the model), motivation and personality, the MARS model may be further modified to its final shape. Job performance is the overall outcome of the contribution of human and situational factors. Human factors include role perceptions, abilities, and motivation, but only the first two are influenced by the level of experience every individual possesses. However, all three factors contain pieces of the personality puzzle. Situational factors correspond to situations (e.g., working environment, budget available, etc.), which support employee work in any organization. Although situational factors are related to experience, they cannot be considered a component of human personality. Job/individual performance from the human perspective are shown in Figure 13.

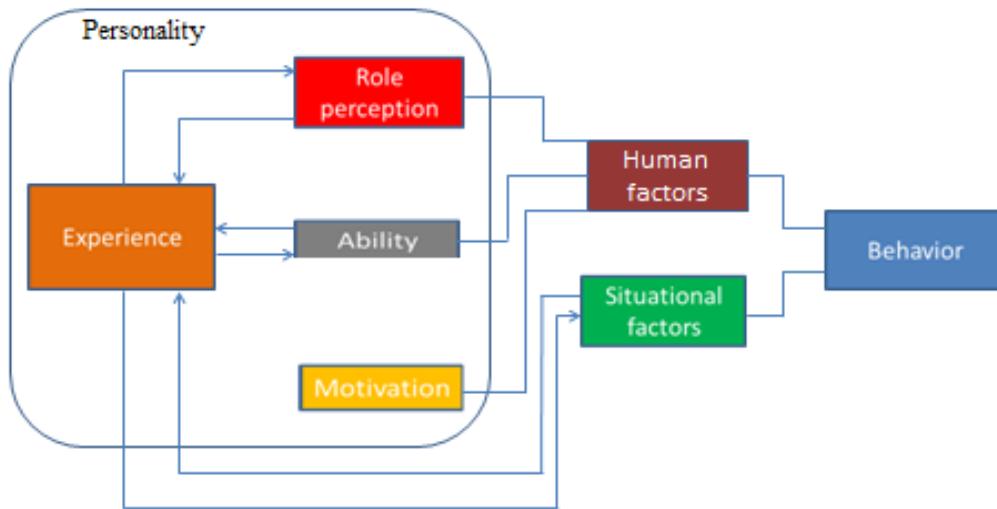


Figure 13. MARS model (final shape)

Job performance, despite what military organizations desire, is primarily a behavior that humans exhibit under different circumstances. It is influenced by a number of traits, among which are experience, ability, motivation and individual personality. These traits interact with one another and modify the MARS model twice. The final model shows behavior as the output of two inputs: human and situational factors. In other words, the output of behavior is another definition of individual performance from the human perspective.

## D. GRADUATE STUDIES

In general terms, graduate studies represent an advanced level of an individual's education. The question arises about the level of job performance that graduates may exhibit. Studies about the relationship between United States naval officers and graduate studies have been made in the past. Their results are very interesting. This section will examine the relationship between HN officers who possess master's degrees and the potential improvement of their job performance.

The HN, through its fully funded postgraduate programs (NPS, Harvard University, and Grandfield University are the main programs for deck officers), targets a positive return on investments (ROI) in the long run. In other words, the HN expects officers who possess master degrees to expose their abilities and increase their job performance as a result of the knowledge, education, and experiences they obtained during their studies. The HN essentially expects these officers to contribute more (compared to those who are just graduates of the HNA) to the increased overall performance of the entire organization. Three things are worth mentioning: the difficulties that an officer of the HN faces when he decides to be a candidate for graduate studies, the uncertain time horizon in which the HN seeks tactically positive returns, and what it means for the HN for an officer to be certified with a master degree.

Bowman and Mehay, in their study of the effect of graduate education on the job performance of professional employees in a single, large hierarchical organization (the USN) present very interesting findings. The data used for the study were drawn from the navy's promotion-history file, which provided background information on all officers reviewed for promotions between 1985 and 1990. Essentially, these data come from officer-fitness reports.

Officers are classified into two categories, line and staff. Line officers are in aviation, ship and submarine operations, while staff officers are those performing administrative functions. Due to characteristics of the military's internal labor market (mission, vertical hierarchy, specific rank structure, etc.), motivation for work effort is stimulated by contests or tournaments. Thus, each officer's promotion rate, or promotion

probability, is based on supply (the different sizes of each year's class/cohorts), demand (the vacant slots in each pay grade), an individual's own ability and effort, and the ability/efforts of others in the same grade. They set as the appropriate measurement for job performance early-promotion recommendations in officer-fitness reports.

Variable	Line officers		Staff officers	
	Master's	No master's	Master's	No master's
Promotion rate	0.86	0.76	0.84	0.70
Early performance <sup>b</sup> rating (%)	36.22	25.63	36.54	28.77
Technical B.A. (%)	0.65	0.67	0.43	0.57
Grade point average <sup>c</sup>	3.12	2.91	3.24	3.08
ROTC (%)	0.27	0.30	0.34	0.27
OCS (%)	0.25	0.26	0.34	0.42
NESEP (%)	0.07	0.07	0.20	0.13
Naval Academy (%)	0.41	0.37	0.12	0.18
Selective college (%)	0.51	0.55	0.65	0.67
Female (%)	0.02	0.01	0.22	0.18
Age	22.90	22.75	23.52	23.60
Married	0.24	0.25	0.19	0.19
Married with children (%)	0.56	0.51	0.54	0.49
Divorced with children (%)	0.01	0.01	0.01	0.03
Single (%)	0.19	0.23	0.26	0.29
Nonwhite	0.04	0.03	0.06	0.06
N	841	3389	858	1495

Figure 14. Descriptive statistics by degree status and occupation (From <sup>34</sup>)

As shown in Figure 14, the variable of "promotion rate" to be higher by ten percentage points for those who possess a degree compared to those who do not (for line officers). The same is true for staff officers, but the difference goes up to fourteen percentage points. Thus, Bowman and Mehay conclude that

... promotion probabilities are ten to fifteen points higher for those with any kind of graduate degree. For those with degrees obtained via the Navy's full-time funded program the differential ranges from fifteen to seventeen points. However, when instruments that are uncorrelated with promotion are used to predict graduate degree status, the results suggest that a sizeable portion of the relationship between graduate education and promotion is due to unobserved attributes that lead some people to attend (or be selected for) graduate school, especially for the Navy's program, and to be more promotable.... Nonetheless, it appears reasonable to conclude that graduate education in this organization works both directly by augmenting firm-specific skills and by providing a mechanism to sort individuals of greatest value to the organization. Individuals who are more career-oriented and who perform well within this organization signal these attributes via their willingness to attend graduate school.... In general, we

find that graduate education improves measures of employee job productivity.<sup>34</sup>

One last observation, which definitely fits for those officers who should be promoted to higher ranks, is the generally accepted principle, was also supported by Rosen, according to which an individual's productivity changes as an officer climbs the chain of command. Therefore, assignment policies should place top performers/capable individuals in the higher-ranking billets. Graduate educational programs of the U.S. Navy have a significant positive effect on labor and unit productivity.

Mehay, (NPS professor, November 2011), notes benefits of ROI in naval graduate education in Figure 15.

Program Outcomes	Benefits to Navy	Monetary Values
I. <u>Increased retention</u>	Reduced accessions	<ul style="list-style-type: none"> <li>•Reduced accession costs and post-accession training costs</li> <li>•Reduced bonuses</li> <li>•Reduced salaries</li> </ul>
II. <u>Increased labor productivity</u> i . In sub-specialty billets ii. In other billets	<ul style="list-style-type: none"> <li>•Increased individual and unit performance</li> <li>•Reduced manpower</li> </ul>	<ul style="list-style-type: none"> <li>•Reduced labor costs</li> </ul>
III. <u>Increased unit productivity</u>	<ul style="list-style-type: none"> <li>•Increased unit and output readiness</li> <li>•Reduced manpower</li> </ul>	<ul style="list-style-type: none"> <li>•Reduced manpower costs</li> </ul>

Figure 15. Potential benefits of graduate education

Figure 15 shows graduate educational programs of the U.S. Navy to have a significant positive effect on labor and unit productivity.

As with every military organization, the HN targets the development of a workforce with core competencies, that is, knowledge, skills, and abilities. Concerning education, the HN funds graduate studies in a number of universities, domestically and abroad, including NPS, Massachusetts Institute of Technology, Harvard University, and Granfield University. Officers who attend these programs obtain a broader level of education and become further specialized in fields such as electronic engineering,

weapon-systems engineering, computer engineering, operational research, naval architecture, and management.

Fully funded programs are not the only option officers have. They can also attend off-duty programs in order to get a certificate of graduate studies. However, the majority of deck officers with master degrees have graduated from NPS or Granfield University. As noted, the HN vision is not only to maintain a workforce with existing core competencies, but to further develop knowledge, skills, and abilities through fully funded programs and build the entire organization's success in the long run. O'Connor, Bronner, and Delaney, point out that:

...developing a workforce with *core competencies* is strategic. Core competencies are the knowledge, skills, abilities, and attitudes the organization has deemed critical to long-term success, such as creative thinking and problem solving; leadership and visioning; and self-development.<sup>35</sup>

Success is the outcome of an organization's effective and efficient performance that has its roots in the job performance of its employees. Through educational programs, the HN seeks an advanced level of job performance from its officers. Furthermore, through officer performance, the HN achieves a higher level of productivity.

The procedure through which deck officer are selected to attend graduate programs should be mentioned. In the beginning of each fiscal year, the HN announces the programs available and the number of deck officers who may attend them (the available slots). Three stages must be followed. If officers have graduated from the HNA with a relatively low GPA, then they follow the first stage, which includes a number of tests in different classes (up to approximately six classes) in technical areas. Officers take these tests in order to correct their low GPA and be accepted by the institutes. If accepted, they enter the second stage, a contest among the officers, again on a number of technical classes and some more theoretical ones. Those who achieve the highest scores, as well as those who have met the HN minimum requirements enter the last stage. Each class's score has to be higher than 100, and the average higher than 130 (max 200). The third stage is officer selection by the Naval Supreme Council. Based on the highest scores, the

number of slots, and the number of officers who have met at least the minimum criteria, the NSC selects those officers who will finally attend the programs.

The procedure allows every graduate of the HNA to participate, no matter his fitness reports. So it is possible for an officer who might be considered a low performer to attend the programs if he gets through the three stages successfully. It is estimated that the time required for an adequate preparation for the test of the technical classes is two or more years.

The preceding analysis of job performance, along with the intense effort an officer has to put in to be selected for a foreign graduate program, reveal individuals who:

- have reached the top layer of Maslow's pyramid of needs hierarchy, the need for growth (meeting new challenges and realizing their potential);
- are self-motivated and driven to acquire an advanced level of knowledge;
- are driven to comprehend (satisfy their curiosity and master the world around them);
- are characterized by the achievement/dependability tendencies of the five-factor model of personality, that is, the dimension of conscientiousness;
- are characterized by the openness-to-experience dimension of the five-factor model (Timothy A. Judge and Joyce E. Bono: “openness to experience is the only big-five trait to display appreciable correlations with intelligence”<sup>33</sup>);
- are determined to combine their experience with further improved cognitive skills and so to adopt an “intelligent living”;

Furthermore, O'Brien, Heppner and Flores state that:

...self-efficacy has been defined as people's judgments in their capabilities to organize and execute courses of action required to attain designated types of performance. Self-efficacy has been shown to predict choice of behavioral activities, effort expended on these activities, persistence despite obstacles, and actual performance.<sup>36</sup>

The precedent characteristics are among those that should be present in the personality of HN officers. Officers who already possess or are willing to get a master's

degree are individuals who signal persistence, despite obstacles or task difficulty. They are individuals who seek further development of their abilities and cognitive skills. In general terms, they direct their behavior in such a manner as to accomplish the even more difficult task. These are the top performers, and this is exactly what possession of a master's degree means to the HN.

#### **E. INDIVIDUAL PERFORMANCE VS MATERIAL**

So far, an analysis of those human factors that should be present in order for an individual to exhibit high levels of individual performance has been completed. However, human factors and individual effort are not enough. In military environments, having the appropriate material plays a significant role because it represents the means of power that military personnel need to execute their tasks. Without the appropriate material, the success of a distinct mission cannot be achieved, even if the personnel might be capable enough. Thus, when an evaluator makes judgments about an officer's job performance, he should always take into account the availability of supporting material. When material does not exist, the evaluator should be able to isolate an officer's potential from the means and then make judgments, even if tasks have not been successfully accomplished.

#### **F. THE MILITARY ENVIRONMENT**

The military environment is a workplace where extended occupational stressors flourish. Some stressors derive from long-lasting deployments away from home; others, from exposure to dangerous and unhealthy working conditions. Dolan and Adler write: "Deployment-related stressors have also been shown to affect psychological and physical health both during deployment and after return to the home station."<sup>37</sup> Stressors may also be present due to a variety of workplace attitudes. "Attitudes represent the cluster of beliefs, assessed feelings, and behavioral intentions towards a person, object or event,"<sup>1</sup> and they form the individual's working environment. Finally, new technologies such as the Internet, which have wired employees to their jobs, heavy workloads, and many hours at work, are other sources of stress. Williams points out that "it is not surprising that too many demands or too many hours was the trigger of workplace stress cited most often by

workers in 2000 (34%). In addition, 15% cited poor interpersonal relations, and 13% cited risk of accident and injury.”<sup>38</sup> She adds that

...not all stress is negative; research has shown that individuals function best in a work setting that places reasonable demands on them. One example of positive stress might be preparing for a job interview. While the preparation may be stressful, getting the resulting promotion is perceived for the most part as a positive event. And many Canadians view stress in a positive light. Indeed, about four in ten respondents in the Canadian Mental Health Survey said that the amount of workplace stress they experienced had a positive effect on their performance, while about three in ten felt it had a negative effect.<sup>38</sup>

Nonetheless, too much stress leads to poor performance, even though individuals might be very capable. Especially in military environments, moderate stress should be in place in order to achieve a high level of performance, but too much stress should be avoided. The reasons are that military personnel use means of technology that provide an extremely wide range of power. Their misuse under heavy stress can have fatal consequences.

## **G. TURNING JOB PERFORMANCE INTO NUMERICAL VALUES**

Job performance is depicted through fitness reports. After the analysis of the military’s characteristics and definitions of job performance from the human perspective, a list with endogenous and exogenous traits that reflect each officer’s job performance within the HN can be extracted. Endogenous traits correspond to personality, and exogenous traits are those related to the environment (working conditions). Higher scores in that list will indicate top performers (war officers) who will be promoted to higher pay grades within the primary war inventory. The lower performers will be transferred to the auxiliary inventory. It is worth mentioning that top performers have significant opportunities to develop their career, since the absorbing state for them will be the rank of flag officers.

A general model showing how all endogenous and exogenous elements play important roles in the behavior (job performance) of every officer in the working environment is presented in Figure 16. Concerning the endogenous traits (human factors),

one can see the interactions of experience with both the environment (in terms of stress) and KSA. This is logical. As the level of experience goes up, it correlates with each individual's potential. Also, officers may become more flexible or more narrow minded, and that has an immediate effect on the quality of their behavior/output. Additionally, graduate studies contribute to an advanced level of KSA and increased motivation for further developing careers. The HN always supports its personnel. Its fully funded graduate programs display the beliefs of Baruch about the new role of organizations.

On the one hand, the career is the “property” of the individual, who may be inspired by new social norms, but on the other hand, for employed people, it is planned and managed to a large extent by their organizations.... \Instead, the organization has a new significant role being supportive, enabler, developer of its human assets.<sup>39</sup>

Thus the HN, indeed, acts as a developer of its human assets. Concerning exogenous traits, the situational factors and the appropriate supporting material contribute to the final output of every officer's behavior. However, in the absence of exogenous traits, officers should be evaluated based exclusively on their endogenous traits.

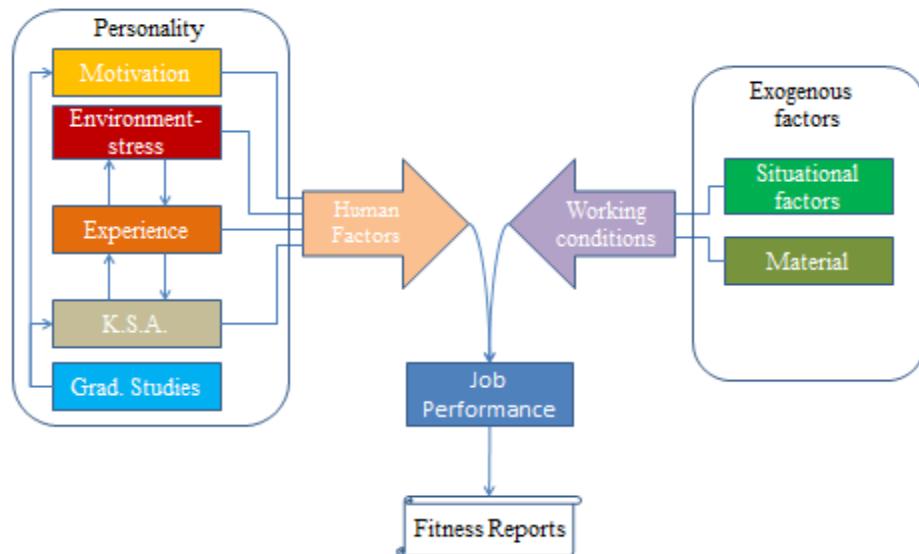


Figure 16. General model of traits that designate job performance.

The general model essentially reveals the specific areas in which officers of the HN should distinguish themselves if they want to develop their careers. However, there are also a few other areas that need to be included in the list, even though they have not

been analyzed. The process of turning job performance into one single numerical value includes three steps.

## **1. Step One of Turning Job Performance into a Single Numerical Value**

Step one in turning job performance into a single numerical value lists the general categories in which officers should be evaluated (measurement of job performance). These categories are the following:

- Health/body conditions

This category has not been analyzed, yet it is considered paramount within military organizations. Of course, some officers, during their careers, may have health disorders. In such cases, transferring them to the auxiliary inventory does not necessarily mean they are poor performers. Instead, such placement protects these officers from worsening health since the assigned tasks are less stressful. In case they recover, they may be able to return to the war inventory, based on performance.

- Level of experience. Mentality level. Personal core values/courage
- Management qualifications
- Professional proficiency
- Naval proficiency and experience
- Ethical values/morality
- Class seniority (graduation from HNA)
- Class seniority (graduation from lieutenant, junior grade, general training).
- Possession of a graduate-studies certificate

## **2. Step Two of Turning Job Performance into a Single Numerical Value**

The second step is to tabulate every category with its subsets. Appendix A includes the tabulated categories. The first column of each table displays the category of evaluation and its subsets. In general terms, the sum of those categories reflects an

officer's level of job performance. The second column includes those characteristics of military organizations that have as premises the elements of the first column. The third and fourth columns show the elements of the five-factor and MARS models that are related to the corresponding subsets. The last column indicates how measurements are applied.

Subjective measurements are very attitudinal, due to the critical thinking of the evaluators. Measurements that are not subjective will not be analyzed in this thesis for the reason that, in some cases, other departments not directly related to an officer's service should provide the evaluator with their estimation. For example, naval hospitals should provide evaluators a number from 1–10 that describes an officer's health and should establish their own criteria for judgment. In other cases, suggestions are given so that decision makers can establish criteria in order to turn the number of accomplished tasks within every service into a single figure that corresponds to officer performance.

An important note should be made about experience. Whenever an officer is promoted, he starts over at the lowest level of experience because, despite the years of service, the thesis considers experience in a new pay grade with new duties to be insufficient.

Measurements for the three categories  $i$ ,  $j$  and  $k$  of appendix A are fixed numbers. Each leadership may decide how many points to assign to an officer, given officer's seniority and the possession or not of an advanced degree. In this thesis, a suggestion is made about the assigned points to facilitate the turn of job performance into a single monetary value. In any case, the pattern of turning performance into a metric remains the same, no matter the point system adopted. Category  $i$  describes the class seniority that results when deck officers graduate from the HNA. In order to assign points, each cohort/class is divided into five groups, each group containing the same number of officers. Suppose there are fifty officers. The first ten officers (constituting the first group) may receive ten points in their fitness report due to their significant seniority. The second, third, fourth, and fifth group get eight, six, four, and two points, respectively. Nonetheless, class seniority may change after the nine-month general training that officers have to attend when promoted to lieutenant, junior grade (O2). Thus, category  $j$

refers to the potential change in class seniority, and the pattern, followed to assign points in fitness reports, is identical with the restated pattern of category *i*. Category *k* refers to the possession of an advanced degree. Officers who have attended fully funded programs abroad get three points due to the difficulties of the selection process described in the section on graduate studies. Those with degrees from domestic institutions get 1.5 points. Officers without an advanced degree receive no points in this category.

### **3. Step Three of Turning Job Performance into a Single Numerical Value**

The third step is very important because performance is now turning into a single numerical value. Among other criteria, according to ordinance 167/A/2010, officers should spend a specific length of service in every pay grade in order to be qualified for promotion. When the officer completes the required years of service, the decision for promotion to the next higher rank is based on job performance scores earned in officer's present pay grade. In other words, job performance scores at the end of the required years of service include the sum of the scores of all annual fitness reports within the specific pay grade. The process is as follows:

- All subsets/categories are graded in a range of one to ten. Currently the evaluation system in the HN includes a range of scores from one to 100. This scoring system should change, because such an extended range becomes too subjective and tends to inflate final scores.
- Evaluators fill up the subjective subsets of each category based on their critical thinking. Then they fill the non-subjective subsets with the proper points established by specific criteria (e.g. categories *i*, *j*, *k*).
- The sum of the subsets divided by their total number is the final score for each category (from *a* to *k*). When all categories are placed in a row, we get a matrix  $A_{ij}$  where its dimensions are  $i=1$  (one officer) and  $j=11$  (the number of categories). The simulated scores of fifteen officers in all categories: five officers each in the O3, O4, and O5 pay grades are shown in Table 2. The

second column shows the simulated year of service for every officer in the specific pay grade. In these pay grades the required time of service is six years.

Table 2. Scores in general categories of evaluation

rank	year in pay grade	Categories of evaluation										
		a	b	c	d	e	f	g	h	i	j	k
1 O3	2	8.50	6.00	7.10	8.10	7.50	8.20	7.00	7.20	6.00	6.00	0.00
2 O3	2	7.30	4.00	8.30	7.20	7.80	7.80	8.40	8.10	10.00	8.00	0.00
3 O3	5	8.40	8.00	8.40	8.50	8.20	8.10	7.70	7.50	8.00	8.00	3.00
4 O3	6	7.90	9.00	7.80	7.70	8.50	8.40	8.00	8.30	4.00	6.00	0.00
5 O3	6	8.20	10.00	7.60	8.00	8.40	7.80	8.30	8.50	2.00	4.00	1.50
1 O4	2	7.80	5.00	8.50	7.90	7.70	7.90	7.20	7.70	8.00	6.00	3.00
2 O4	2	8.60	6.00	8.40	7.80	8.00	7.80	8.30	8.10	2.00	4.00	3.00
3 O4	4	7.00	8.00	7.80	8.20	7.50	8.50	7.50	7.90	10.00	8.00	0.00
4 O4	5	7.30	8.00	7.20	7.40	8.30	8.40	8.00	8.50	10.00	10.00	0.00
5 O4	6	8.00	10.00	8.10	8.40	8.20	7.60	7.20	7.60	8.00	8.00	0.00
1 O5	2	7.90	6.00	8.50	7.60	7.00	7.40	7.50	7.20	4.00	4.00	0.00
2 O5	2	7.60	6.00	8.10	8.40	7.80	7.70	8.30	7.80	6.00	6.00	0.00
3 O5	3	8.20	4.00	8.30	7.90	7.40	8.20	7.90	8.00	8.00	8.00	3.00
4 O5	4	7.90	8.00	7.80	7.70	8.20	8.50	8.10	8.30	2.00	4.00	1.50
5 O5	5	8.40	9.00	8.20	8.10	8.40	7.90	8.40	7.60	10.00	8.00	3.00

- A new concept for the HN is suggested, based on the observation that no officer is perfect because no person on earth is perfect. Thus, the NSC, given its military characteristics, but mainly the HN's national mission, has to establish priorities, in terms of weight for each category. Worth must be assigned to each category. In this thesis, the weights vary from 0.1 to 1 and weights have been set subjectively. Of course, the NSCI may adjust them. The model will not change.
- In this phase, a matrix  $B_{jk}$  is created where  $j=11$  (the number of categories) and  $k=1$  (the weight of every category). The different weights for every general category of evaluation and pay grade are shown in Table 3. It is important to mention that weights should also differ among pay grades,

because as an officer climbs the chain of command, he needs to develop leadership skills. Thus, different weights reflect the priorities of the HN for these skills among the pay grades.

Table 3. Weights of general categories

Categories	O3 weight	O4 weight	O5 weight
a	0.70	a 0.60	a 0.70
b	0.60	b 0.70	b 1.00
c	0.80	c 0.90	c 0.90
d	0.40	d 0.40	d 0.40
e	1.00	e 1.00	e 0.80
f	1.00	f 1.00	f 1.00
g	0.90	g 0.80	g 0.60
h	0.50	h 0.50	h 0.50
i	0.20	i 0.20	i 0.20
j	0.10	j 0.10	j 0.10
k	0.30	k 0.30	k 0.30

- Next the two matrices are multiplied, and the result is a new matrix C with dimensions 1x1. In other words, we get a number that corresponds to the overall job performance of every officer, as the second column of Table 4 shows. The formula that justifies the above multiplication is the following:

$$A_{ij} \times B_{jk} = C_{ik}$$

where  $i = 1, j = 11, k = 1$ .

- Within a service, the annual average grade (or the median, which might be better) of every evaluator is estimated (Table 4, second column). This is different for every pay grade. For instance, if a service is manned with five O3s, five O4s and five O5s, then there should be three different averages of fitness reports for each pay grade.
- The results of differences between the scores of fitness reports and evaluator averages are summed and shown in the third column of Table 4.

Table 4. Scores of fitness reports, evaluator's averages, final difference

rank	perform	average	difference
O3	45.87	48.816	2.946
O3	47.04	48.816	1.776
O3	51.08	48.816	-2.264
O3	49.9	48.816	-1.084
O3	50.19	48.816	-1.374
O4	47.3	48.872	1.572
O4	48.23	48.872	0.642
O4	48.85	48.872	0.022
O4	49.77	48.872	-0.898
O4	50.21	48.872	-1.338
O5	44.52	47.85	3.33
O5	46.59	47.85	1.26
O5	46.53	47.85	1.32
O5	48.95	47.85	-1.1
O5	52.66	47.85	-4.81

- The same procedure is followed for fitness reports filled out in the past six years for all officers. At the end of the sixth year, all the differences are summed up and the total score of each officer's job performance is computed. This is the overall performance in the specific pay grade. The scores can be positive or negative. A positive job performance indicates someone who exhibits higher performance than an officer with a negative score.

The use of weights and the calculation of each evaluator's averages are used to eliminate subjectivity. Especially for the averages (the step that leads to the calculation of differences), elimination of each evaluator's subjectivity is achieved when the averages are placed on the  $x$ -axis of a graph, and differences are measured from that axis.

However, calculating only the average may not be enough. Minimum and maximum grades of every evaluator should also be taken into account. It is important that this be done because of the various potential ranges of grades among evaluators. Various ranges may lead to selection errors. Thus, a mathematical model should be developed to normalize the restated ranges so that a common ground exists among all evaluators.

Fitness reports are documents that show the job performance of an officer in a military environment. Job performance is a combination of endogenous and exogenous traits in the HN. Endogenous traits correspond to each individual's personality, and exogenous traits are those related to environment (working conditions). In this thesis, exogenous traits are considered stable, and job performance is measured based solely on endogenous traits. Their analysis indicates which categories should be evaluated and, furthermore, what subsets are included within the general categories. Indeed, few subsets may be measured based on actual events. The rest are subjective, so the need to eliminate evaluator subjectivity emerges.

For that reason, weighting is applied to every category to indicate the priorities of importance that leadership should establish. Additionally, evaluator averages enter the process of turning job performance into one single numerical value so as to overcome the obstacles of subjectivity. In the end, a single number—positive or negative—represents overall job performance. Officers with positive figures exhibit a higher level of performance than those with negative scores.

### III. THE MARKOV-CHAIN MODEL

#### A. DATA FOR DECK OFFICERS OF THE HELLENIC NAVY

Information concerning deck officers of the Hellenic navy is divided into three categories.

##### 1. Inventory of Data of HN Officers

The first category of officer distribution at every pay grade of the existing inventory in 2010 is shown in Table 5. The two parallel inventories research is still underway.

Table 5. Number of existing deck officers in each pay grade and corresponding billets

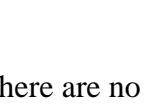
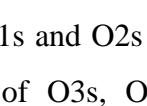
Pay grades		Existing number of deck officers	Billets
Ensign or O1		74	400
Lieutenant, Junior or O2		282	
Lieutenant or O3		302	284
Lt. Commander or O4		266	217
Commander or O5		201	198
Captain or O6		80	79
Commodore or O7		19	18
Rear Admiral or O8		7	7
Vice Admiral or O9		2	2
Chief of Hellenic Navy General Staff		1	1

Table 5 shows that there are no separate billets for the first and second pay grades. Furthermore, the sum of O1s and O2s is less than the corresponding billets. Unlike O1s and O2s, the population of O3s, O4s and O5s exceeds the corresponding billets.

Concerning O7s, this is not a serious problem since their population is almost equal to the billets. The rest of the pay grades are not of concern for this thesis because they are considered the absorbing states of deck officers. The number of officers and billets in the HN are shown in Figure 17.

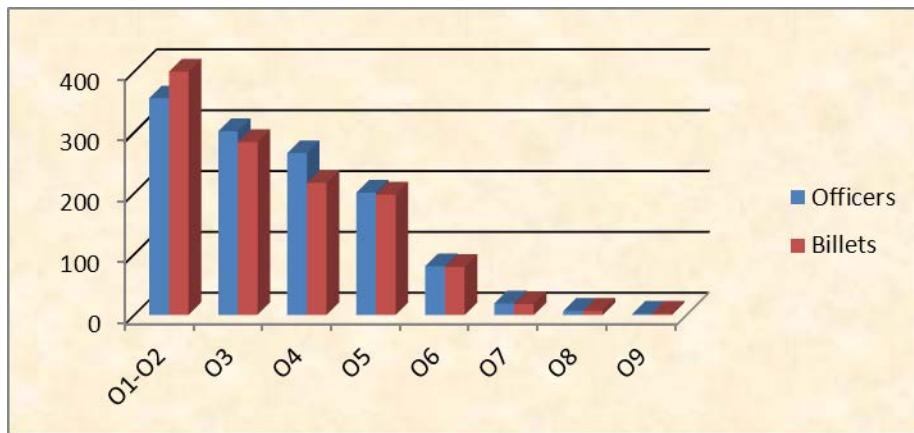


Figure 17. Officers of the HN and corresponding billets in each pay grade.

## 2. Second Category of Data of HN Officers

The years of service required at each pay grade, according to ordinance 167/A/2010 is shown in Table 6.

Table 6. Required years by pay grade.

Pay grades		Required years in each pay grade	Total years of service
Ensign or O1		4	9
Lieutenant, Junior or O2		5	
Lieutenant or O3		6	15
Lt. Commander or O4		6	21
Commander or O5		6	27
Captain or O6		4	31

It is worth mentioning that an officer with 31 years of service has essentially completed 35 years of service, since his time spent in the Hellenic Naval Academy (four years of studies) is added to service time. Thus, he is qualified for a full pension.

Promotions from O1s to O2s are made at the completion of their fourth year of service. Correspondingly, O2s are promoted to O3s on the completion of their fifth year of service as O2s. The same procedure applies for the rest of the pay grades of the chain of command.

### **3. Third Category of Data of HN Officers**

The third category of detailed information concerning the distribution of officers in each pay grade (classes) along with their graduation year from the HNA, is shown in Table 7. This is important because, though promotions to the next pay grade are implemented based on various criteria, the basic premise is to complete the required years of service.



Figure 18. Graduation ceremony in the HNA

Table 7. Number of graduates, year of graduation, total officers

Year of graduation	<b>2008</b>	<b>1990</b>	<b>1995</b>	<b>1991</b>	<b>1984</b>	<b>1981</b>
Number of grads	32	1	1	38	1	2
Year of graduation	<b>2009</b>	<b>2001</b>	<b>1996</b>	<b>1992</b>	<b>1986</b>	<b>1982</b>
Number of grads	24	1	32	49	1	6
Year of graduation	<b>2010</b>	<b>2002</b>	<b>1997</b>	<b>1993</b>	<b>1987</b>	<b>1983</b>
Number of grads	18	48	1	49	35	10
Year of graduation		<b>2003</b>	<b>1997</b>	<b>1994</b>	<b>1988</b>	<b>1984</b>
Number of grads		61	50	41	34	19
Year of graduation		<b>2004</b>	<b>1998</b>	<b>1995</b>	<b>1989</b>	<b>1985</b>
Number of grads		50	74	53	54	16
Year of graduation		<b>2005</b>	<b>1999</b>	<b>1995</b>	<b>1990</b>	<b>1986</b>
Number of grads		47	59	2	51	23
Year of graduation		<b>2006</b>	<b>2000</b>	<b>1996</b>	<b>1991</b>	<b>1987</b>
Number of grads		38	37	34	25	4
Year of graduation		<b>2007</b>	<b>2001</b>			
Number of grads		36	1			
Year of graduation			<b>2001</b>			
Number of grads			47			
pool		<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>8</b>
Not in the pool	74	280	299	264	199	72
Total	<b>74</b>	<b>282</b>	<b>302</b>	<b>266</b>	<b>201</b>	<b>80</b>

The shaded areas in Table 7 indicate officers who have been excluded from promotion procedures. For some reason, they are not qualified for promotion, and they continue in the same pay grade until they complete the required 35 years of service to receive a full pension. This specific category of officers comprises the pool.

## B. CONCEPTUAL FRAMEWORK/DESCRIPTION OF MARKOV-CHAIN MODELS

Military organizations, as has been stated, build their chain of command on a specific rank structure. In other words, there are fixed ranks and billets through which an officer may climb the chain of command. The HN can be referred to as a heterogeneous system, a system that classifies people to “such things as grades, age, or location.”<sup>40</sup> Therefore, the HN manpower system is perceived “as a set of interconnected stocks and

flows.”<sup>40</sup> Stocks are the distribution of officers in each pay grade and the total officer population. Flows represent the transitions to the next state. To facilitate both the understanding and control of the stated set of quantities (for stocks and flows), a dynamic model is applied. This model will exhibit the effects of different applied strategies and policies to these sets of quantities. This dynamic model (the Markov-Chain models), should take into consideration restraints (transition probabilities) and limits (vacancies in billets) that flow from the specific rank structure, applying strategies, policies, and assumptions about an officer’s job performance. The model, while changing its inputs, can be a useful tool estimating various manpower outcomes concerning the number of officers that the HN wants to employ throughout the years and under alternative policies.

Based on the transition probabilities, which are the primary input of the model and represent the states in which an officer, at the end of a year, may remain at the same rank or be promoted to the next higher rank, or leave the military, the model can be used to estimate a number of manpower outputs. One of the outputs presents the total population of officers of the HN after n-years, given as a second input a fixed number of office accessions ( $R[T]$ , where  $R$  is the number of accessions at time  $T$ ). It is important to mention that the HN recruits officers only from one source, the HNA. Thus, accessions are implemented only in the pay grade of O1.

Another output of the model might be to compute the number of appropriate accessions that should be implemented every year for the HN to maintain a fixed total population of officers. Again, the primary input would be the fixed transition probabilities, whereas the second input—this time—is the goal of a fixed officer population. The model, in addition, presents the distribution of officers in each pay grade throughout the years.

The model can also be used in a number of other versions. An example would be to calculate the number of appropriate accessions so as to increase the total number of officers by a certain percentage for every year. Another possibility would be to estimate the average length of officer service in each pay grade. Unfortunately, the last version cannot be applied to the HN, because of restrictions related to the required years of service in each pay grade as shown in Table 6.

Nonetheless, the thesis uses Markov models to help the HN maintain a fixed total-officer population for a time horizon of five years and to correct the deficiencies related to distribution of officers to the corresponding billets in every pay grade.

### C. METHODOLOGY OF THE MARKOV-CHAIN MODEL

The following analysis demonstrates the methodology used by Markov-chain models through sort examples. The first two examples include the states of continuing in the same rank or being promoted to the next higher rank. The third example contains the former two states plus the “attrite” state.

#### 1. Calculation of Distribution of Officers in Each Pay Grade under Steady-Transition Probabilities (States of Continuing Unpromoted or Being Promoted)

Suppose that in the year 2000 a military organization includes officers of three pay grades, in particular O1s, O2s and O3s. The transition probabilities of these officers is shown in Figure 19.

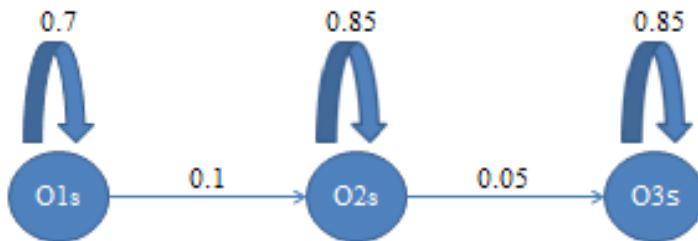


Figure 19. States and Transitions

Table 8 does not contain a wastage option. Thus, the sum of probabilities in every pay grade is less than one (the maximum value of a probability is one, whereas the minimum is zero). The matrix used in Markov-chain models with a probability of 0.7 for an O1 officer to continue in the same pay grade for another year and a probability of 0.1 for his promotion to the next higher rank (O2) is shown in Table 8. Correspondingly, an O2

officer has a probability of 0.85 of continuing in the same pay grade for one more year, whereas his promotion probability is 0.05. Finally, the corresponding probability for an O3 to continue as an O3 is 0.85.

Table 8. Transition probabilities

	O1s	O2s	O3s
O1s	0.7	0.1	0
O2s	0	0.85	0.05
O3s	0	0	0.85

The military organization recruits officers on an annual basis in every pay grade. The number of accessions is fixed  $[R(T) : (48, 11, 5)]$ . In other words, the organization recruits 48 officers in the first pay grade, eleven officers in the second pay grade and five officers in the last pay grade, as Table 9 shows.

Table 9. Fixed recruits per pay grade.

	O1s	O2s	O3s
R(T)	48	11	5

Furthermore, the distribution of officers in the organization's inventory for the same year,  $n(2000)$ , is shown in Table 10.

Table 10. Number of officers in each pay grade for the year 2000.

	O1s	O2s	O3s
n(2000)	200	150	73

The question is how many officers the organization will employ in each pay grade in the year 2001.

Starting from the O1s, the probability of continuing in the same pay grade for one more year is 0.7 (70%). There are also 48 recruits (a fixed number for every year). Thus, 140 officers continue as O1s.

Adding the 48 recruits, the number of O1s (year 2001) becomes 188 officers. Equation (1) shows the calculation of officers in the first pay grade for the year 2001.

$$O1: n_{o1}(2001) = 150 \cdot 0.7 + 48 \Rightarrow n_{o1}(2001) = 188 \quad (1)$$

The same equation is used to compute the number of officers of the second pay grade (O2). However, one difference in the O2 pay grade is that, apart from those officers who continue as O2s and the eleven recruits, there are also a few officers (O1s) who are promoted to O2s. Thus, there is an additional term in equation (2):

$$O2: n_{o2}(2001) = 150 \cdot 0.85 + 11 + 200 \cdot 0.10 \Rightarrow n_{o2}(2001) \approx 158 \quad (2)$$

The same pattern applies for the last pay grade, due to three sources of officers: officers who continue as O3s, officers promoted to O3 and five new recruits. Thus:

$$O3: n_{o3}(2001) = 73 \cdot 0.85 + 5 + 150 \cdot 0.05 \Rightarrow n_{o3}(2001) \approx 74 \quad (3)$$

The distribution of officers in each pay grade and the total officer population for the years 2000 and 2001 is shown in Table 11.

Table 11. Status of officers in 2000 and 2001

	O1s	O2s	O3s	Total
2000	200	150	73	423
2001	188	158	74	420

## 2. Calculation of Accessions under Steady Transition Probabilities and a Steady Total Number of Officers (States of Continuing or Being Promoted)

Unlike the previous example, the problem in this case is to calculate the number of accessions in the first pay grade in order to maintain a fixed total population of officers throughout the years. Additionally, the model estimates how the distribution of officers in pay grades is being reformed. In other words, using the same information as in the previous example—transition probabilities, distribution of officers in the year 2000 and total population of officers (423)—the organization wants to find how many officers (as O1s) need to be recruited and the final distribution of its officers in order to maintain a total workforce of 423 individuals.

The O1s for the year 2001 will be equal to:

$$O1: n_{o1}(2001) = 200 \cdot 0.7 + x_1 \Rightarrow n_{o1}(2001) = 140 + x_1 \quad (4)$$

where  $x_1$  is the number of recruits in the first pay grade.

The number of O2s for the year 2001 will be equal to:

$$O2: n_{o2}(2001) = 200 \cdot 0.1 + 150 \cdot 0.85 + 0 \cdot x_2 \Rightarrow n_{o2}(2001) \approx 147 \quad (5)$$

where  $x_2$  is the number of recruits in the second pay grade. However, in this example, the organization does not recruit officers as O2s. Thus,  $x_2$  is multiplied by zero.

The number of O3s for the year 2001 will be equal to:

$$O3: n_{o3}(2001) = 150 \cdot 0.05 + 73 \cdot 0.85 + 0 \cdot x_3 \Rightarrow n_{o3}(2001) \approx 70 \quad (6)$$

where  $x_3$  is the number of O3 recruits. As with O2s, there are no recruits in the third pay grade, so  $x_3$  is multiplied by zero.

Now, the organization wants to maintain the same workforce of 423 officers for the year 2001. Thus, equations (4), (5) and (6) are totaled and their sum is equal to 423 officers,

$$140 + x_1 + 147 + 70 = 423 \Rightarrow 357 + x_1 = 423 \Rightarrow x_1 = 66 \quad (7)$$

which is the number of recruits (as O1s) needed for the organization to maintain the same workforce. If we substitute  $x_1 = 66$  in equation (4), then the number of O1s (for the year 2001) becomes 206 individuals. The results are tabulated in Table 12.

Table 12. Distribution of officers in each pay grade for the year 2001

	O1s	O2s	O3s	Total
n(2000)	200	150	73	423
n(2001)	206	147	70	423

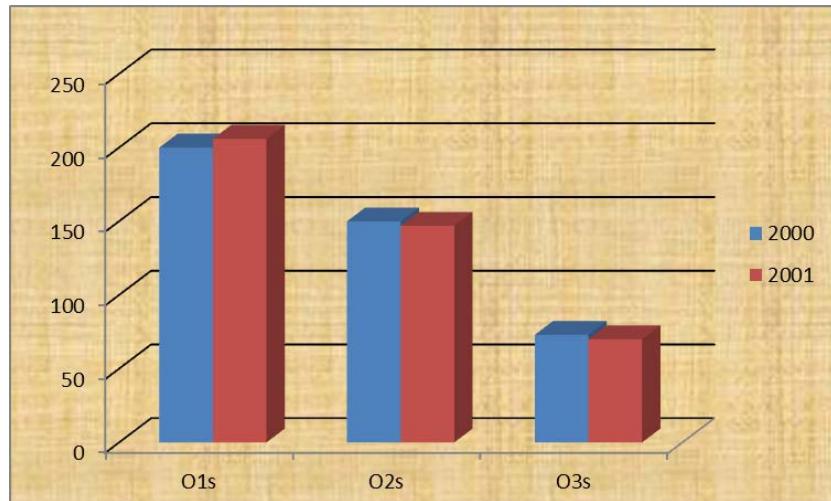


Figure 20. Differences in distribution of officers (2000, 2001)

### **3. Calculation of Distribution of Officers in Each Pay Grade under Steady Transition Probabilities and Increased Number of Total Inventory (States of Continuing or Being Promoted or Attrited)**

This example is more complex because all three states are present. The three states and the transition probabilities are shown in Figure 21.

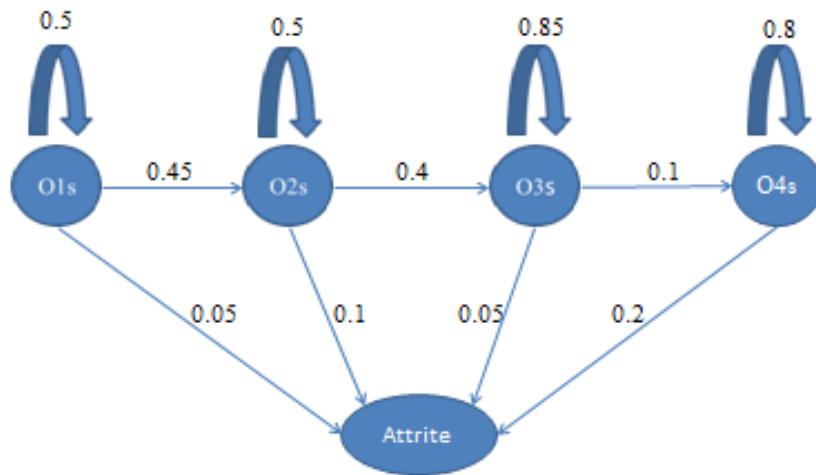


Figure 21. States and transition probabilities

The transition tabulations probabilities are shown in Table 13. Unlike the examples with two states as input, this example uses all three of them and the sum of the corresponding transition probabilities equals one. That always happens when all three states are present.

Table 13. Transition probabilities for the three states

	O1s	O2s	O3s	O4s	Attrite
O1s	0.5	0.45	0	0	0.05
O2s	0	0.5	0.4	0	0.1
O3s	0	0	0.85	0.1	0.05
O4s	0	0	0	0.8	0.2
Attrite	0	0	0	0	1

The organization's inventory for the year 2000 is shown in Table 14. In this example, the organization has set as its goal employing 150 more officers at the beginning of the year 2002. The starting inventory is 1000 officers (year 2000). However, there are few restrictions concerning the 150 officers. The first year (2001), the organization wants to increase its workforce by 100 officers and no more. In the second year, the organization wants to employ 50 more officers. This pattern increases the workforce of the organization to 1100 officers the first year and to 1150 officers (the goal) in the second year. As with Example 2, accessions are referred only to the first rank.

Table 14. Organization's inventory (2000)

	O1s	O2s	O3s	O4s
n(2000)	250	250	300	200

Given the stated information, the challenge that emerges is the calculation of the appropriate number of accessions that the organization should implement.

Starting from the year 2001, the solution is similar to the solution of the second example. The state of attrition covers the difference that has to be taken into account. The equations and the computations for the number of officers in each pay grade are shown in Figure 22.

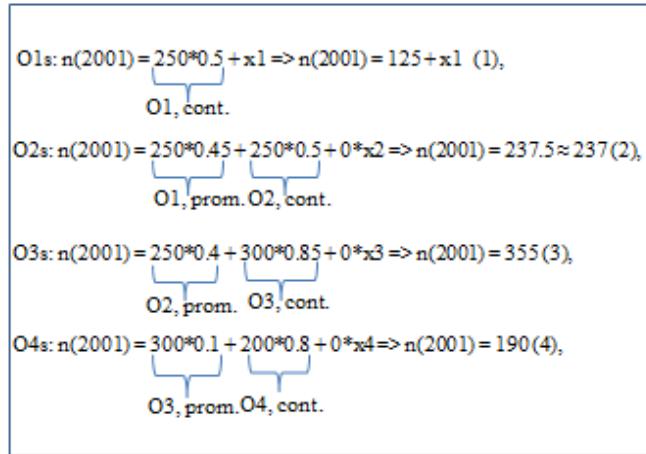


Figure 22. Computation of inventory of officers in each pay grade

Attrition for the year 2001 is equal to:

$$n_{att}(2001) = 250 \cdot 0.05 + 250 \cdot 0.1 + 300 \cdot 0.05 + 200 \cdot 0.2 \Rightarrow n_{att}(2001) = 92.5 \approx 93 \quad (8)$$

The organization's inventory for the year 2001 should be 1100 officers. Thus, the sum of equations (1) to (4), shown in figure 22, must equal 1100.

$$125 + x_1 + 237 + 355 + 190 = 1100 \Rightarrow x_1 = 193 \quad (9)$$

Now, we substitute  $x_1 = 193$  in equation (1) of figure 22 and the inventory of O1s for the year 2001 is figured at 318 officers. Table 15 shows the distribution of officers in years 2000–2001.

Table 15. Distribution of officers for the year 2000–2001

	O1s	O2s	O3s	O4s	TOTAL	Attrition
2000	250	250	300	200	1000	0
2001	318	237	355	190	1100	93

Moving to the next year (2002), the same process is followed. However the inventory of 2001 (Table 15) will be the basis for the new equations to be set up.

The previous examples involve the arithmetic, but time-consuming, approach of the Markov-chain models. Nevertheless, the arithmetic approach is the foundation, based on which Excel may quickly solve similar problems. Furthermore, the model of the third example is the basic tool this thesis uses to adjust and calculate the inventory of officers

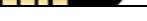
of the HN in every pay grade within a time horizon of five years. Unlike the previous examples, the HN's transition probabilities are not fixed, nor are they input. Instead, they will be output.

#### D. CRITERIA REVIEW

The HN has established various criteria for promotions, whose analysis is presented in the following description.

- There are two categories that comprise the basis of officer promotions, both mentioned in ordinance 167/A/ 24.9.2010. The first category is the specific time of service in every pay grade that sets aside early promotions, making them meaningless for the HN. The second category is relative to the first one, since it designates specific time of service at sea within every pay grade. Service at sea is crucial for officers with pay grades from O1 to O5. Service at sea is described in Table 16 (blue cells).

Table 16. Required years of service at sea, required years of service in each pay grade

Pay grades		Required years of service at sea.	Required years of service in each pay grade
Ensign or O1		3	4
Lieutenant, Junior or O2		3	5
Lieutenant or O3		3	6
Lt. Commander or O4		2	6
Commander or O5		2	6

The criteria for service at sea differ for captains (or O6s). In order to be qualified for promotion to the next higher rank (flag officers), captains should have served a minimum of ten years at sea during their entire career. Furthermore, they should also have served as commanders of a squadron of ships or of specific services ashore. In this thesis, the criterion of service at sea takes into consideration the following:

- The vacancies in every pay grade.
- The sizes of each year's classes (or cohorts). The class sizes in every pay grade are shown in Figures 23 to 28.

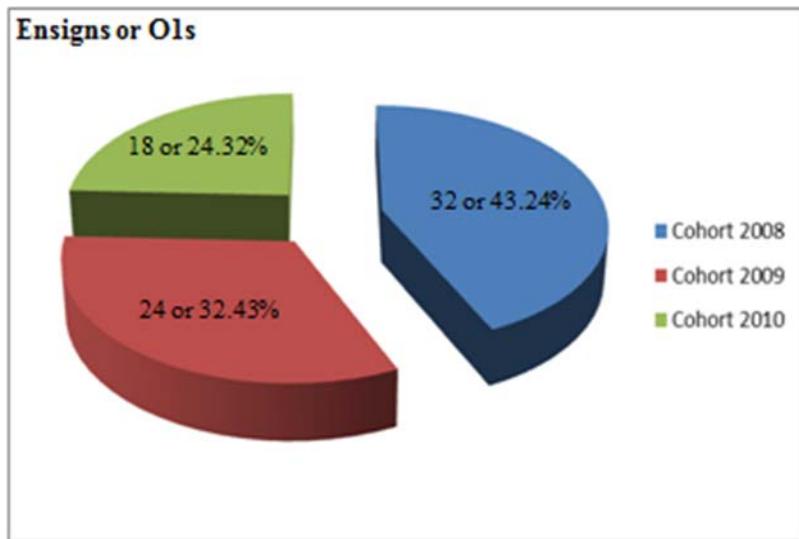


Figure 23. Cohort sizes in the pay grade of O1s

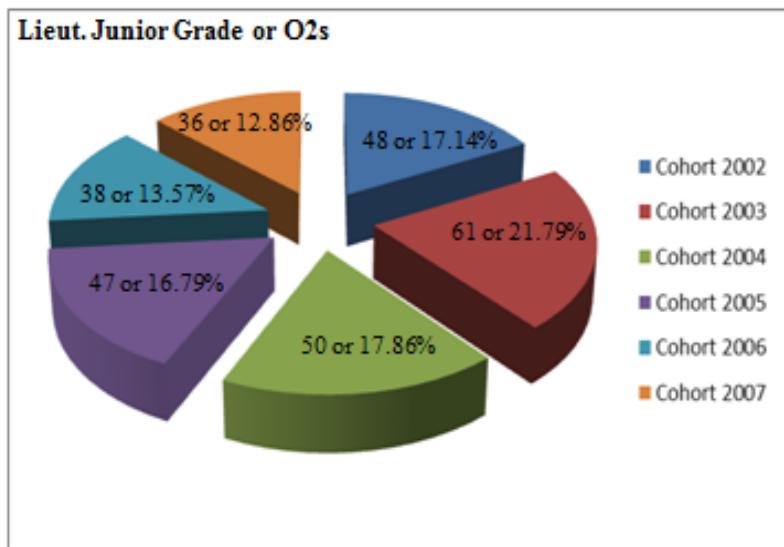


Figure 24. Cohort sizes in the pay grade of O2s

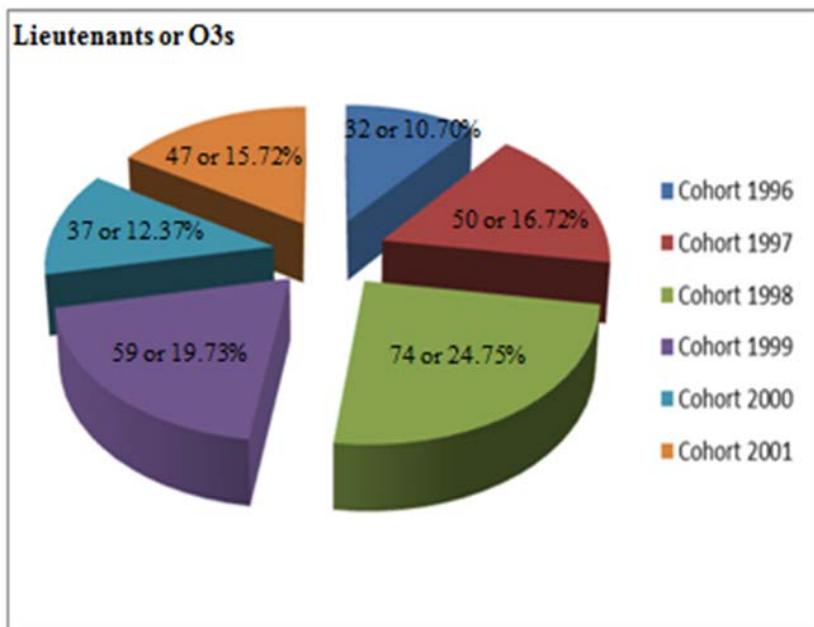


Figure 25. Cohort sizes in the pay grade of O3s

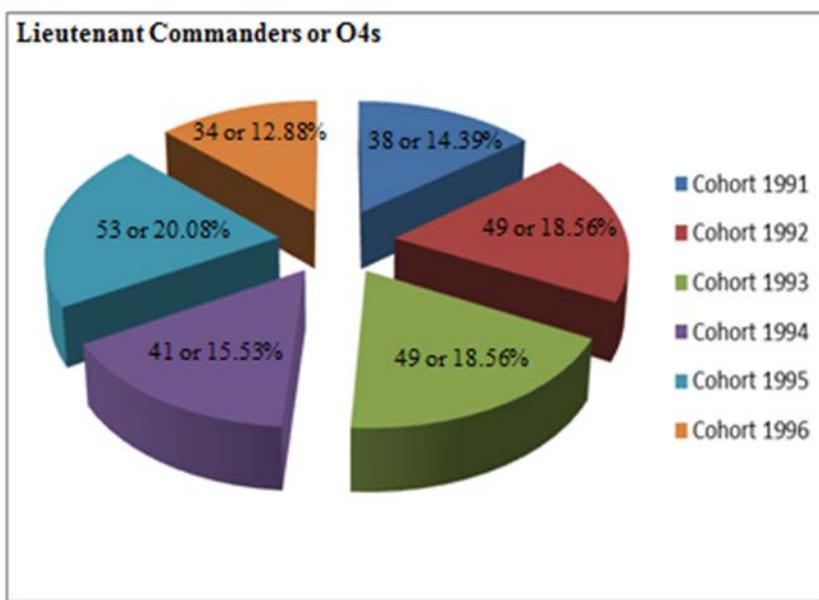


Figure 26. Cohort sizes in the pay grade of O4s

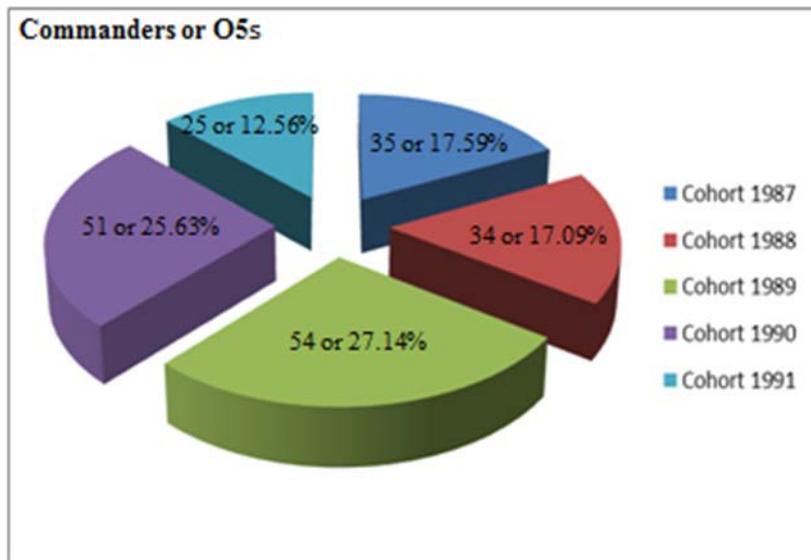


Figure 27. Cohort sizes in the pay grade of O5s

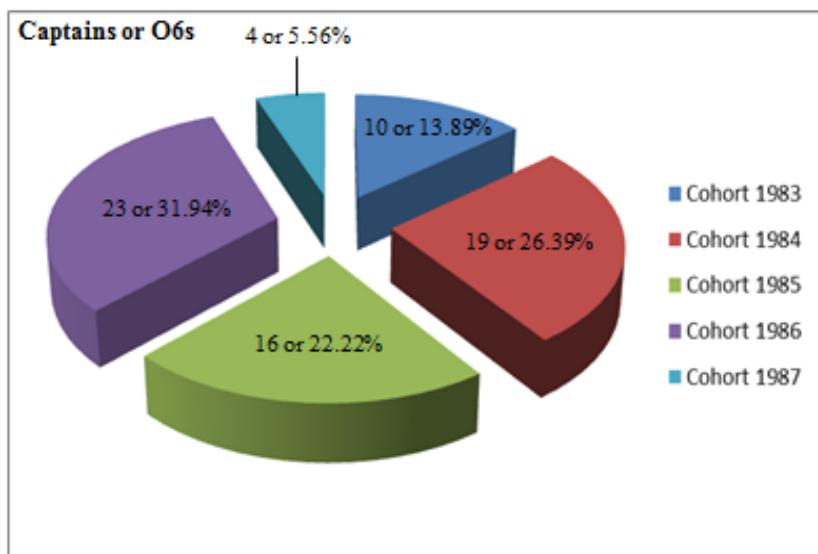


Figure 28. Cohort sizes in the pay grade of O6s

In Figures 23 to 28, officers already in the “pool” have been excluded. The scores of job performance are taken into account in the promotion process. Nonetheless, a reformed calculation of job performance (see Chapter II, section F, and Chapter III) revolutionizes the process of promotions.

## **E. SUMMARY**

Rank structure is a basic characteristic of military organizations. In particular, fixed ranks and billets comprise the chain of command in which officers evolve. The rank structure points to a heterogeneous system, a system that classifies people in such things as grades. As with other military organizations, the HN's promotion processes are based on stocks and flows. Stocks are the distribution of officers in every pay grade and the total population of officers. Flows are the transitions to the next state. A dynamic model such as Markov-chain model facilitates both the understanding and control of stocks and flows after the implementation of various strategies and policies. When changing inputs in Markov-chain models, manpower experts can estimate different manpower outcomes about military personnel.

Primarily, the model is based on transition probabilities (primary input) to estimate the size of manpower output. One output might be the total population of HN officers after a few years, when the second input is a fixed number of accessions. An important issue for the HN is that accessions of officers are only implemented in the first pay grade of the HN chain of command. Another output of the model might be the calculation of appropriate accessions when the second input is a fixed population of the HN workforce throughout a specific time horizon. In this case, a distribution of officers in every pay grade is also calculated.

Regardless of the change of input in Markov-Chain models and the established criteria of the HN promotion processes, this thesis (chapter IV) uses little input as a basic platform for calculations. This input is size of each year's classes (cohorts), the vacancies in each pay grade, the specific time of service in every pay grade, and the scores of job performance with a corresponding reformed calculation.

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## **IV. ANALYSIS AND APPLICATION OF THE MARKOV-CHAIN MODEL FOR THE HELLENIC NAVY**

### **A. MAJOR ISSUES FOR THE HN**

The Hellenic navy confronts two major problems. The first one is to conform to ordinance 167/A/ 24.9.2010 concerning required years of service in each pay grade. The second is to correct the deficiencies that exist in the primary war-inventory. In other words, the HN desires to match the number of officers in each pay grade with corresponding billets, within a time horizon of five years. For that reason, the alternative plan of two parallel inventories, war and auxiliary, should be established.

In this case, in order to apply Markov models to HN inventory, transition probabilities will be simulated based on the information in Table 18.

### **B. FIXING DEFICIENCIES AMONG CLASSES AND REQUIRED YEARS OF SERVICE**

The HN desires to correct deficiencies in its officer inventory and to adjust the distribution of officers to corresponding billets within five years. Table 17 shows these deficiencies for the year 2010, concerning classes (graduation year) and time of service in each pay grade according to ordinance 167/A/ 24.9.2010.

Table 17. Gaps between classes (year of graduation) and required years of service in all pay grades (year 2010)

Classes	3	6	6	6	5	5
Ordinance	4	5	6	6	6	4

In order to mesh classes with required years of service in every pay grade and then apply Markov models, a few new policies should be adopted. The following policies are suggested:

- Starting from ensigns (or O1s), the 2008 class should be divided into two cohorts. Officers of the first pay grade (O1s) are very young; thus, the criteria for their promotion should combine their seniority and the scores of their job performance. By maintaining part of the 2008 class as O1s, a match between the classes of O1s and the requirements of ordinance 167/A/ 24.9.2010 (required time of service in each pay grade) is achieved, especially when 2011 grads enter the chain of command.
- Unlike O1s, officers of the 2002 and 2003 classes (O2s) should be promoted to the next pay grade. However, due to their total number, it is not possible for all of them to be promoted to the next pay grade. Thus, only the 2002 class will be promoted in the first year.
- Likewise O2s, those left from the class of 1996 (32 officers) and a few officers from the class of 1997 should move to the next state (promotion to O4s or transfer to auxiliary inventory). It is worth mentioning that the 1996 class has already been divided into two cohorts, because 34 officers are already O4s. However, after the promotion process of the second cohort, the class is united.
- As with officers of the classes of 1996–1997, the 1991 and 1992 classes of lieutenant commanders (or O4s) should move to the next state (promotion or transfer to the auxiliary inventory). Again, the 1991 class has already been divided into two cohorts because 25 grads are already O5s.
- Concerning commanders (or O5s), only a few officers of the second cohort of class 1987 (35 officers) should move to the next state and be united with the first cohort of that class (four officers).
- Finally, for the time being, early promotions are meaningless for the HN. However, this policy needs to be revised, and doing so will definitely affect transition probabilities.

The restated suggestions of flow of officers for the period 2010–2011 are presented in Tables 18, 19.

Table 18. Classes of officers in each pay grade for the year 2010

Graduation year	2008A	2002	1996B	1991B	1987B	1983
Graduation year	2008B	2003	1997	1992	1988	1984
Graduation year	2009	2004	1998	1993	1989	1985
Graduation year	2010	2005	1999	1994	1990	1986
Graduation year		2006	2000	1995	1991A	1987A
Graduation year		2007	2001	1996A		
Existing classes	4	6	6	6	5	5
Ordinance	4	5	6	6	6	4

Table 19. Classes of officers in each pay grade for the year 2011

Graduation year	2008B	2003	1997B	1992B	1987B	1984
Graduation year	2009	2004	1998	1993	1988	1985
Graduation year	2010	2005	1999	1994	1989	1986
Graduation year	2011	2006	2000	1995	1990	1987A
Graduation year		2007	2001	1996	1991	
Graduation year		2008A	2002	1997A	1992A	
Existing classes	4	6	6	6	6	4
Ordinance	4	5	6	6	6	4

One sees that for the first year (2010 to 2011) early promotions should be adopted for the classes of 1997 and 1992 as shown in Tables 18, 19.

### C. CALCULATION OF ACCESSIONS FOR THE PERIOD 2010–2011

It has already been stated that one of the basic criteria for an officer of the HN to be promoted is specific time of service in each pay grade. Thus, only those officers who are in the last year of service in each pay grade may be promoted. However, a few admissions should be made in order for the HN to maintain the fixed inventory of 1178 officers (equal to the billets of O1s to O6s) for a time horizon of five years. These admissions are the following:

- Those officers in the pool are excluded from the promotion process.
- Accessions in the first pay grade should range between 50 and 65 per year.
- For O1s and O2s, there are only two states: continue in the same pay grade for one more year and be promoted to the next higher rank.

- For pay grades O3, O4 and O5, there is one additional state, being transferred to the auxiliary inventory. The third state can also be characterized as the absorbing state. The question that emerges in this situation is which officers from which classes will be transferred to the auxiliary inventory. Decision makers should designate the classes. Then, the answer is based on job performance scores. Having analyzed the way in which job performance scores are calculated, the HN will transfer those officers with the lowest scores to the auxiliary inventory.
- For O6s, promotion to flag officer and transfer to the auxiliary inventory is considered their absorbing state.

The calculation of transition probabilities of officers is shown in Tables 20 to 25.

Table 20. Transition rates of O1s (2010–2011)

	total	auxiliary	new total	continue	promote
2008A	16	0	16	0	16
2008B	16	0	16	16	0
2009	24	0	24	24	0
2010	18	0	18	18	0
Transition probabilities					
total	74		Continue	Promote	Auxiliary
			0.78	0.22	0.00
					1.00

Table 21. Transition rates of O2s (2010–2011)

	total	auxiliary	new total	continue	promote
2002	48	0	48	0	48
2003	61	0	61	61	0
2004	50	0	50	50	0
2005	47	0	47	47	0
2006	38	0	38	38	0
2007	36	0	36	36	0
Transition probabilities					
total	280		Continue	Promote	Auxiliary
			0.83	0.17	0.00
					1.00

Table 22. Transition rates of O3s (2010–2011)

	total	auxiliary	new total	continue	promote	
1996B	32	4	28	0	28	
1997	50	4	46	31	15	
1998	74	7	67	67	0	
1999	59	4	55	55	0	
2000	37	0	37	37	0	
2001	47	0	47	47	0	
Transition probabilities						
total	299			Continue	Promote	Auxiliary
				0.79	0.14	0.06
						1.00

Table 23. Transition rates of O4s (2010–2011)

	total	auxiliary	new total	continue	promote	
1991B	38	5	33	0	33	
1992	49	4	40	40	5	
1993	49	3	46	46	0	
1994	41	3	38	38	0	
1995	53	4	49	49	0	
1996A	34	0	34	34	0	
Transition probabilities						
total	264			Continue	Promote	Auxiliary
				0.78	0.14	0.07
						1.00

Table 24. Transition rates of O5s (2010–2011)

	total	auxiliary	new total	continue	promote	
1987B	35	5	30	5	25	
1988	34	3	31	31	0	
1989	54	4	50	50	0	
1990	51	2	49	49	0	
1991A	25	0	25	25	0	
Transition probabilities						
total	199			Continue	Promote	Auxiliary
				0.80	0.13	0.07
						1.00

Table 25. Transition rates of O6s (2010–2011)

	total	auxiliary	new total	continue	promote	
1983	10	3	7	0	7	
1984	19	3	16	16	0	
1985	16	2	14	14	0	
1986	23	3	20	20	0	
1987A	4	0	4	4	0	
Transition probabilities						
total	72			Continue	Promote	Auxiliary
				0.75	0.10	0.15
						1.00

Transition rates in Tables 20 to 25 are inputs to the calculation of accessions for the first period, 2010 to 2011, shown in Table 26.

Table 26. Accessions—flow of officers for the year 2010–2011

	O1	O2	O3	O4	O5	O6	SUPREM	AUXILIA	
O1	0.78	0.22	0.00	0.00	0.00	0.00	0.00	0.00	
O2	0.00	0.83	0.17	0.00	0.00	0.00	0.00	0.00	
O3	0.00	0.00	0.79	0.14	0.00	0.00	0.00	0.06	
O4	0.00	0.00	0.00	0.78	0.14	0.00	0.00	0.07	
O5	0.00	0.00	0.00	0.00	0.80	0.13	0.00	0.07	
O6	0.00	0.00	0.00	0.00	0.00	0.75	0.10	0.15	
SUPREM	0	0	0	0	0	0	1	0	
AUXIL	0	0	0	0	0	0	0	1	
billets		400.00	284.00	217.00	198.00	79.00	18.00		tot act target
n(0)	74	280	299	264	199	72	0	0	1188
n(1)	118	248	285	250	198	79	7	63	1178 1178
					mse		0		
R	r								
60	1	0	0	0	0	0	0	0	

Table 26 shows the number of accessions in the first pay grade (60 officers) and the distribution of officers in the year 2011, given the calculated transition probabilities and the fixed total population of 1178 officers.

Table 27. Distribution of officers in the year 2011

	2008B	2003	1997B	1992B	1987B	1984
Grad year	2008B	2003	1997B	1992B	1987B	1984
Num grad	16	61	31	40	5	16
Grad year	2009	2004	1998	1993	1988	1985
Num grad	24	50	67	46	31	14
Grad year	2010	2005	1999	1994	1989	1986
Num grad	18	47	55	38	50	20
Grad year	2011	2006	2000	1995	1990	1987A
Num grad	60	38	37	49	49	29
Grad year		2007	2001	1996	1991	
Num grad		36	47	62	58	
Grad year		2008A	2002	1997A	1992A	
Num grad		16	48	15	5	
total num	118	248	285	250	198	79
		366			total	1178
billets		400	284	217	198	79
					total	1178

A synopsis of the calculations for the period between 2010-2011 is shown in Table 27. Distribution of officers in every pay grade along with their date of graduation from the HNA is also presented. Furthermore, it is obvious that early promotions applied to the classes of 1992 and 1997. As a result, these classes were divided into two segments. There are some deficiencies concerning the distribution of officers in pay grades and designated billets, despite the fixed total number of officers. In particular, the total number of O1s and O2s is less than the number of designated billets by 34 officers, and there are more O3s and O4s than the billets by one and 33 officers, respectively. The distribution of O5s and O6s is equal to the corresponding billets. Finally, the classes in the second pay grade (O2) should be reduced to five so that the chain of command can be fully aligned with ordinance 167/A/ 24.9.2010.

In order to minimize existing deficiencies and to apply Markov models, the HN should designate fixed transition probabilities for a four-year period. Whenever necessary, officers with the lowest scores in job performance will be transferred to the auxiliary inventory.

## D. APPLICATION OF MARKOV-CHAIN MODELS FOR THE PERIOD 2011–2015

After classes/cohorts of officers have been matched with the required years of service in every pay grade in accordance with ordinance 167/A/24.9.2010, Markov models can be applied.

To facilitate the understanding of Markov-model application, classes/cohorts are renamed, as shown in Table 28.

Table 28. Renamed classes/cohorts. Sizes of renamed classes/cohorts (2011)

Classes/Cohorts											
2008B	O1-1	2003	O2-1	1997B	O3-1	1992B	O4-1	1987A	O5-1	1984	O6-1
	16		61		31		40		5		16
2009	O1-2	2004	O2-2	1998	O3-2	1993	O4-2	1988	O5-2	1985	O6-2
	24		50		67		46		31		14
2010	O1-3	2005	O2-3	1999	O3-3	1994	O4-3	1989	O5-3	1986	O6-3
	18		47		55		38		50		20
2011	O1-4	2006	O2-4	2000	O3-4	1995	O4-4	1990	O5-4	1987A	O6-4
	60		38		37		49		49		29
		2007	O2-5	2001	O3-5	1996	O4-5	1991	O5-5		
			36		47		62		58		
		2008A	O2-6	2002	O3-6	1997A	O4-6	1992A	O5-6		
			16		48		15		5		
total nun		118		248		285		250		198	79
				366						total	1178
billets			400		284		217		198	79	
									total		1178

O1 to O6 corresponds to the pay grades as shown in Table 28. The figures that follow show the year of service in each pay grade. In other words, an O4-4 officer is one who has the pay grade of O4 and is in the fourth year of service in this specific pay grade.

### 1. Transition Probabilities

In order to apply Markov-chain models, the HN establishes fixed transition probabilities. For the thesis, simulated transition probabilities are presented, as follows.

#### a. *Transition Probabilities of O1s*

Officers with the pay grade of O1 have only two states, to continue in the same pay grade for one more year or be promoted to the next higher rank (O2-1).

However, according to ordinance 167/A/24.9.2010, only O1-4s can be promoted to the pay grade of O2-1. Transition probabilities for O1s are presented in Table 29.

Table 29. Transition probabilities of O1s (2011–2015)

	O1-1	O1-2	O1-3	O1-4	promotion
O1-1	0	1	0	0	0
O1-2	0	0	1	0	0
O1-3	0	0	0	1	0
O1-4	0	0	0	0	1

*b. Transition Probabilities of O2s*

The transition probabilities of O2s follow exactly the same pattern as with O1s. In other words, every officer continues in the same pay grade for one more year, and only those at the sixth year of service are promoted to the next higher rank (O3-1). Transition probabilities of O2s are shown in Table 30.

Table 30. Transition probabilities of O2s (2011–2015)

	O2-1	O2-2	O2-3	O2-4	O2-5	O2-6	promotion
O2-1	0	1	0	0	0	0	0
O2-2	0	0	1	0	0	0	0
O2-3	0	0	0	1	0	0	0
O2-4	0	0	0	0	1	0	0
O2-5	0	0	0	0	0	1	0
O2-6	0	0	0	0	0	0	1

*c. Transition Probabilities of O3s*

At this pay grade, an additional state is present: transfer to the auxiliary inventory of officers. Officers who are transferred are those with the lowest scores in job performance. The transition probabilities of O3s are presented in Table 31.

Table 31. Transition probabilities of O3s (2011–2015)

	O3-1	O3-2	O3-3	O3-4	O3-5	O3-6	promotion	auxiliary
O3-1	0	1	0	0	0	0	0	0
O3-2	0	0	1	0	0	0	0	0
O3-3	0	0	0	1	0	0	0	0
O3-4	0	0	0	0	1	0	0	0
O3-5	0	0	0	0	0	0.85	0.12	0.03
O3-6	0	0	0	0	0	0	0.95	0.05

Table 31 shows that early promotion is present at this pay grade. In addition to those officers at the sixth year of service, officers at the fifth year of service may also be promoted to the next higher rank (O4-1).

#### *d. Transition Probabilities of O4s*

As with O3s, officers at the pay grade of O4 have three states. The transition probabilities are shown in Table 32.

Table 32. Transition Probabilities of O4s (2011–2015)

	O4-1	O4-2	O4-3	O4-4	O4-5	O4-6	promotion	auxiliary
O4-1	0	1	0	0	0	0	0	0
O4-2	0	0	1	0	0	0	0	0
O4-3	0	0	0	1	0	0	0	0
O4-4	0	0	0	0	1	0	0	0
O4-5	0	0	0	0	0	0.1	0.8	0.1
O4-6	0	0	0	0	0	0	0.9	0.1

Again, as with O3s, early promotion is also present in this pay grade. Officers in the fifth year of service may be promoted to next higher rank (O5-1).

#### *e. Transition Probabilities of O5s*

Again, there are three states in this pay grade. The transition probabilities are shown in Table 33.

Table 33. Transition probabilities of O5s (2011–2015)

	O5-1	O5-2	O5-3	O5-4	O5-5	O5-6	promotion	auxiliary
O5-1	0	0.9	0	0	0	0	0	0.1
O5-2	0	0	0.9	0	0	0	0	0.1
O5-3	0	0	0	0.8	0	0	0	0.2
O5-4	0	0	0	0	0.8	0	0	0.2
O5-5	0	0	0	0	0	0.75	0.15	0.1
O5-6	0	0	0	0	0	0	0.8	0.2

Officers in the fifth year of service may be promoted to the next higher rank (O6-1) as shown in Table 33.

#### f. *Transition Probabilities of O6s*

Officers of this pay grade may continue for one more year in the same pay grade, be promoted to flag officers, or be transferred to the auxiliary inventory. Table 34 shows the transition probabilities of O6s.

Table 34. Transition Probabilities of O6s (2011–2015)

	O6-1	O6-2	O6-3	O6-4	promotion	auxiliary
O6-1	0	0.8	0	0	0	0.2
O6-2	0	0	0.75	0	0	0.25
O6-3	0	0	0	0.8	0.1	0.1
O6-4	0	0	0	0	0.4	0.6

The process of early promotion is also present at this pay grade.

The states and transition probabilities of the pay grades of O3, O4, O5, and O6 are shown in Figure 29.

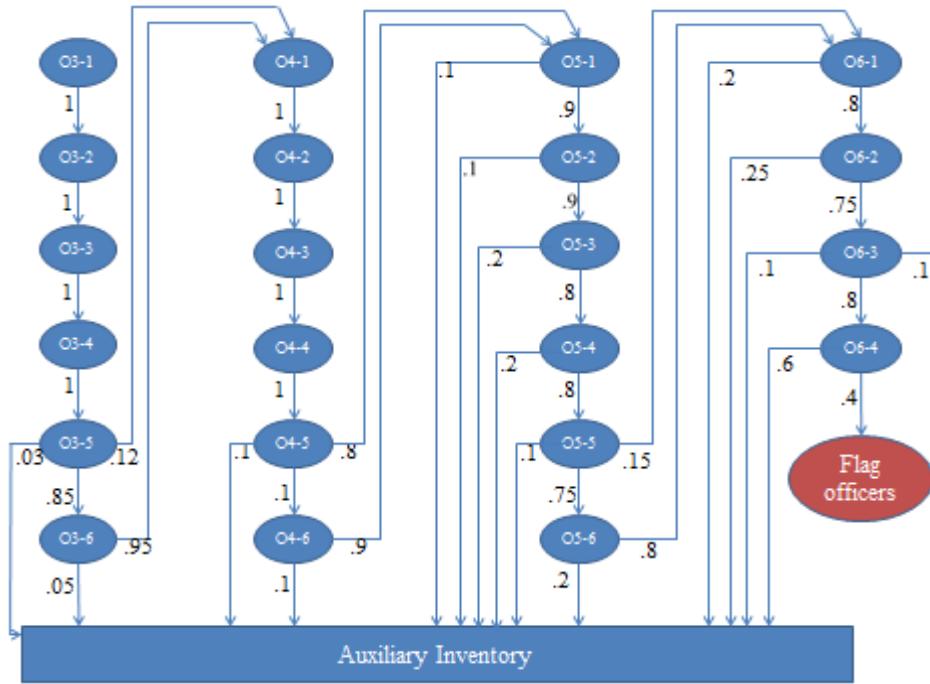


Figure 29. States–transition probabilities for O3s, O4s, O5s and O6s

## 2. Application of Markov-Chain Models

Given the steady transition probabilities of Tables 29 to 34, Markov models are applied. The model is displayed in the Appendix B.

## E. RESULTS OF THE APPLICATION OF MARKOV-CHAIN MODELS IN THE HELLENIC NAVY'S WAR AND AUXILIARY INVENTORY

### 1. Number of Officer Accessions

The number of accessions in the first pay grade (O1-1) required to correct the deficiencies at the end of the fifth year (2015) is shown in Table 35.

Table 35. Accessions in the first year of service of the first pay grade (O1-1)

	2012	2013	2014	2015	total
Accessions	61	59	53	57	230

## 2. Distribution of Officers in 2015

The distribution of war officers in every pay grade at the end of the year 2015 and the corresponding billets are shown in Table 36.

Table 36. Final distribution of war officers (2015) in every pay grade with corresponding billets

Pay Grades	P	O1	O2	O3	O4	O5	O6	B
Distribution	O1-4	O2-6	O3-6	O4-6	O5-6	O6-4		
2015	61	36	40	6	25	4		
	O1-3	O2-5	O3-5	O4-5	O5-5	O6-3		
	59	16	48	15	3	15		
	O1-2	O2-4	O3-4	O4-4	O5-4	O6-2		
	53	16	61	37	47	23		
	O1-1	O2-3	O3-3	O4-3	O5-3	O6-1		
	57	24	50	61	28	24		
	O2-2	O3-2	O4-2	O5-2				
	18	47	49	38				
	O2-1	O3-1	O4-1	O5-1				
	60	38	36	54				
total num	230	170	284	204	195	66		
		400						
War Inventory (total)					total	1149		
Billets		400	284	217	198	79		
Billets (total)					total	1178		
Auxiliary Inventory					total	233		

Given the transition probabilities, Table 36 shows that the sum of officers with the pay grade of O1 and O2 and officers with the pay grade of O3 are equal to the number of corresponding billets. The number of officers of the forth pay grade (O4) is fewer than the billets. However, the gap of thirteen officers can be filled by transferring thirteen top performers (O4s) from the auxiliary to war inventory. In the fifth pay grade, there is a minor difference of three officers between the distribution and the corresponding billets. This gap can be filled by retrieving three top performers (O5s) from the auxiliary inventory. As with O4s, there are fewer officers of the sixth pay grade than corresponding billets. This deficiency can be resolved by transferring thirteen officers of the auxiliary inventory who have exhibited high levels of job performance. Finally, retrieving top

performers of the auxiliary inventory may correct deficiencies concerning the distribution of officers in every pay grade. Simultaneously, the total inventory may be kept fixed.

The application of a Markov-chain model for the period 2011 to 2015, in which the HN desires to correct deficiencies and adjust its distribution of officers to designated billets, is effective. Deficiencies have been significantly limited. However, the auxiliary inventory counts 233 officers whose scores in job performance are lower than war officers. This pool of officers may be used to complement the war inventory to correct its deficiencies wherever necessary. Top performers of the auxiliary inventory may be transferred to war inventory to fill, not only gaps in any pay grade (O3 and above), but also to correct any deficiencies regarding the total war inventory. Thus, the auxiliary inventory essentially complements the war inventory, keeping it always fixed.

## **V. SUMMARY—CONCLUSIONS AND RECOMMENDATIONS**

### **A. SUMMARY**

Hellas is currently suffering from a financial crisis because of over-lending which led to the 2009 recession. The recession continues to plague the nation, and remedies to avoid a countrywide collapse are being examined in governmental, private, and public sectors. The HMoD is striving to reduce costs while maintaining operational readiness. One government level being examined is retirement legislation for military personnel. Specifically, changes to the required length of service in each pay grade are being examined in accordance with Presidency of the Hellenic Republic ordinance 167/A/24.9.2010.

The Hellenic navy faces two notable challenges. Firstly, it is adjusting the years of service in each pay grade in accordance with ordinance 167/A/24.9.2010. Secondly, the HN is examining differences between force structure and officer inventory in the next five years.

Under these conditions that the crisis has caused, existing policies do not support the proposed legislation. This research models different methods for the HN to establish new policy to successfully implement Hellenic Republic legislation, ordinance 167/A/24.9.2010.

### **B. CONCLUSIONS AND RECOMMENDATIONS**

#### **1. Primary Research Questions**

- a. *Which Promotion Policies Meet Required Officer Accessions so that Only Top Performers Track to War Officer Inventory?***

#### **Conclusions:**

The United States Navy, through early promotion recommendations, distinguishes between top and average performers among its officers. Currently the HN requires 35 years of service and bases promotions on specific years of service at each pay grade. All officers who stay 35 years will receive a full pension.

### **Recommendation:**

- Have the Department of personnel divide the officer inventory into two officer tracks, war and auxiliary. The war track would include top performing officers as identified through the fitness report system. The second track includes officers whose fitness performance do not meet current war inventory fitness report criteria. Top performers, apart from receiving a full pension at the end of their careers, will also have the opportunity to promote to flag officers, unlike officers that remain in the auxiliary inventory.
- The HN should provide early promotion opportunities for top performers in pay grades O3 and above. This will facilitate the application of ordinance 167/A/24.9.2010, with respect to the required years of service in each pay grade. Early promotion would be based on fitness report scores.

***b. Can Components such as Experience, Ability (Performance), Motivation, and Attainment of Advanced Degrees Reliably Convert Performance into a Metric with a Numerical Value?***

### **Conclusions:**

The majority of the criteria that identify top performers currently exist in the HN fitness reporting system. In order to further clarify top performers in the future, some identifiers must be added. The critical criteria that need to be clarified are experience, ability (performance), motivation, and attainment of advanced degrees.

Experience has traditionally been used as a primary factor in evaluating job performance, but it cannot alone control for the level of an officer's job performance. Experience needs to be combined with various levels of education in order to be a component of evaluation. Ability, from the performance perspective, is a highly valued component of fitness reports at almost every pay grade. Higher ranks in a military chain of command require an advanced level of general ability, because these officers are required to make decisions under various conditions of uncertainty. These decisions are often made in stressful and hazardous conditions unknown to the average citizen. Motivation has proven to be the dominant behavior that shapes an individual's ability to

accomplish unforeseen tasks. Finally, while graduate studies do not necessarily make officers experts, officers who possess or who are willing to attain an advanced degree show characteristics of persistence and ambition. These persistent and ambitious individuals are more motivated and apt to accomplish assigned tasks despite obstacles and they deserve to receive extra credit in fitness reports.

**Recommendation:**

- HN leadership must re-evaluate the appropriate weighting of the experience component in fitness reports. However, starting from the pay grade of O3, the assigned weight becomes more critical to officers promotion.
- The HN needs to examine the weight it places on management qualifications which represent ability from a performance perspective. The examination needs to occur specifically in the middle and higher pay grades.
- The HN must incorporate a motivation component in fitness reports from the perspective of individual behavior. In other words, when assigning points in fitness reports, evaluators should take into account task accomplishment regardless the prevailed conditions of the working environment.
- The HN should include graduate education as an evaluation field in fitness reports. Officers who possess an advanced degree must be evaluated differently than officers without graduate education.

**2. Secondary Research Questions**

*a. What Practices Should Be Adopted to Turn Fitness Reports into an Objective Tool for Promotion Processes?*

**Conclusions:**

The HN needs to separate top performers from those with lower evaluation scores. The solution is to calculate the average grade of fitness reports of every evaluator. Officers with a high level of job performance are considered those with scores above the average grade of their evaluator, whereas poor performers are those whose scores are below. Thus, job performance is expressed as the difference between

the score of an officer's fitness report and the average grade of the evaluator. This concept is very important because it minimizes evaluator's subjectivity even though fitness reports are based on subjective perceptions. However, calculating averages only may not be enough. The minimum and maximum grades of every evaluator should also be taken into account. It is important because large variations in ranges among evaluators may lead to selection errors.

This calculation will help officers to motivate themselves and improve their level of performance. As an overall outcome, it will improve the performance of the HN as an entity. Graduation from HNA and Lieutenant, junior grade and general training class seniority is also an indicator of performance in an officers career.

**Recommendation:**

- Develop a mathematical model to normalize the restated ranges so that a common ground exists among all evaluators.
- Establish weights for every field of the fitness report.
- Graduation from HNA and Lieutenant, junior grade and general training class seniority is an indicator of performance in an officers career and must be added to the fitness reporting system.

***b. How Can War and Auxiliary Inventories Be Estimated Over Five Years***

**Conclusions:**

Markov-chain models have estimated the HN war and auxiliary inventories. The model showed that deficiencies in war inventory have been significantly reduced or will be equal to the requirements of ordinance 167/A/24.9.2010 by the end of 2015. Nonetheless, another inventory (auxiliary) consisting of 233 officers with low job performance scores has been created. Additionally the model showed that inflation in the middle pay grades will have been eliminated by the end of 2015 as identified in appendix B.

**Recommendation:**

Use top performers from the auxiliary to compensate for shortfalls in the war inventory as necessary.

**C. FUTURE RESEARCH**

The HN should conduct research on how to improve performance of top performing auxiliary-officers. The research should examine how well these auxiliary officers perform in the war inventory.

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## APPENDIX A

Table 37. Health/body category and its subsets

Category (a)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Health/body condition				
Subsets				
(a1)Body conditions	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Standard working conditions</li> </ul>	-	-	<ul style="list-style-type: none"> <li>•Annual Physical training tests</li> </ul>
(a2)Healthy condition	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Limited budget</li> <li>•Mixed set of personnel</li> <li>•Extended Working Hours</li> <li>•Standard working conditions</li> <li>•Limited discharge</li> </ul>	•Neuroticism	-	<ul style="list-style-type: none"> <li>•Annual physical exams</li> </ul>
(a3)Visits to hospitals	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Extended Working Hours</li> <li>•Standard working conditions</li> </ul>	-	-	Records of the number of visits

Table 38. Experience level category and subsets

Category (b)	Military characteristics	Five-factor model of personality	MARS model	Measurement
b. Experience level				
Subsets				
(b1)Actual years of service	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Limited budget</li> <li>•Mixed set of personnel</li> <li>•Limited discharge</li> </ul>	<ul style="list-style-type: none"> <li>•Neuroticism</li> <li>•Openness to experience</li> </ul>	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Role perception</li> <li>•Ability</li> <li>•Situational factors</li> </ul>	Number of years
(b2)Years of tenure in the same duty	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Limited budget</li> <li>•Mixed set of personnel</li> <li>•Limited discharge</li> </ul>	<ul style="list-style-type: none"> <li>•Extroversion</li> <li>•Agreeableness</li> <li>•Conscientiousness</li> <li>•Neuroticism</li> <li>•Openness to experience</li> </ul>	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Role perception</li> <li>•Ability</li> <li>•Situational factors</li> </ul>	Number of years

Table 39. Mentality level category and its subsets

Category (c)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Mentality level				
Subsets				
(c1)Intellect/judgment	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Limited budget</li> <li>•Mixed set of personnel</li> <li>•Limited discharge</li> <li>•Sub-culture</li> </ul>	<ul style="list-style-type: none"> <li>•Extroversion</li> <li>•Conscientiousness</li> <li>•Openness to experience</li> </ul>	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Role perception</li> <li>•Ability</li> <li>•Situational factors</li> </ul>	subjective
(c2)Communication skills(written, oral)	<ul style="list-style-type: none"> <li>•Mixed set of personnel</li> <li>•Limited discharge</li> <li>•Sub-culture</li> </ul>	<ul style="list-style-type: none"> <li>•Conscientiousness</li> <li>•Neuroticism</li> </ul>	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Ability</li> </ul>	subjective

Table 40. Personal core values/ courage category and its subsets

Category (d)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Personal core values/courage				
Subsets				
(d1)Courage in the phase of physical dangers	•Distinct mission •Extroversion •Neuroticism	•Personality •Ability •Situational factors	Subjective	
(d2)Initiative	•Distinct mission •Limited budget •Mixed set of personnel •Extended working hours •Limited discharge •Subculture	•Extroversion •Openness to experience	•Experience •Role perception •Ability •Motivation •Situational factors	subjective
(d3)Stress	•Distinct mission •Extended working hours •Subculture	•Neuroticism •Openness to experience	•Personality	Subjective
(d4)Adherence to the Hellenic Navy's history/traditions	•Distinct mission •History/traditions	-	•Personality	Subjective
(d5)Officer loyalty	•Distinct mission •Rank Structure •Pay structure •Extended Working hours •History/traditions	•Conscientiousness	•Personality •Motivation	Subjective

Table 41. Management qualifications category and its subsets

Category (e)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Management qualifications				
Subsets				
(e1)Managing subordinates effectively	<ul style="list-style-type: none"> <li>•Mixed set of personnel</li> <li>•Extended Working hours</li> <li>•Standard working conditions</li> <li>•Limited discharge</li> </ul>	<ul style="list-style-type: none"> <li>•Extroversion</li> <li>•Agreeableness</li> <li>•Openness to experience</li> </ul>	<ul style="list-style-type: none"> <li>•Experience</li> <li>•Ability</li> <li>•Situational factors</li> </ul>	subjective
(e2)Inspiring discipline in subordinates	<ul style="list-style-type: none"> <li>•Distinct mission</li> <li>•Mixed set of personnel</li> <li>•Extended working hours</li> <li>History/traditions</li> </ul>	<ul style="list-style-type: none"> <li>•Extroversion</li> <li>•Openness to experience</li> </ul>	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Experience</li> <li>•Ability</li> </ul>	Subjective
(e3)Caring about the needs of subordinates	<ul style="list-style-type: none"> <li>•Distinct mission</li> <li>•Rank Structure</li> <li>•Pay structure</li> <li>•Extended working hours</li> </ul>	•Agreeableness	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Situational factors</li> </ul>	Subjective
(e4)Communicating the goals of the organization to the subordinates	<ul style="list-style-type: none"> <li>•Distinct mission</li> <li>•Limited budget</li> <li>•Extended working hours</li> <li>•Subculture</li> </ul>	•Extroversion	<ul style="list-style-type: none"> <li>•Personality</li> <li>•Ability</li> <li>•Motivation</li> <li>•Situational factors</li> </ul>	Subjective

Table 42. Professional proficiency category and its subsets

Category (f)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Professional proficiency.				
Subsets				
(f1)Expert knowledge	•Distinct Mission	•Extroversion •Conscientiousness •Openness to experience	•Role perception •Ability •Motivation •Situational factors	Subjective
(f2)Caring about public wealth	•Standard working conditions	•Openness to experience	•Role perception	Subjective
(f3)Officer complaints <sup>41</sup>	•Distinct Mission	•Neuroticism	•Ability •Motivation	Number of training programs attended
(f4)Training abilities	•Distinct Mission	•Extroversion •Conscientiousness •Neuroticism •Openness to experience	•Experience •Ability •Motivation	Subjective
(f5)Violation of safety rules	•Distinct Mission •Limited budget •Extended Working Hours •Standard working conditions •Sub-culture •History/traditions	•Neuroticism	•Role perception •Situational factors	Number of accidents
(f6)Absenteeism	•Extended Working Hours •Standard working conditions	•Neuroticism	•Personality •Motivation •Situational factors	Number of absences from work

Table 43. Naval proficiency and experience category and its subsets

Category (g)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Naval proficiency and experience				
Subsets				
(g1)Sea sickness	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Extended Working Hours</li> </ul>	<ul style="list-style-type: none"> <li>•Neuroticism</li> </ul>	<ul style="list-style-type: none"> <li>•Situational factors</li> </ul>	Visits to dispensary
(g2)Ship handling	<ul style="list-style-type: none"> <li>•Distinct Mission</li> </ul>	-	<ul style="list-style-type: none"> <li>•Experience</li> <li>•Ability</li> <li>•Motivation</li> <li>•Situational factors</li> </ul>	Check of precise maneuvers in specific exercises
(g3)Seacraft abilities	<ul style="list-style-type: none"> <li>•Distinct Mission</li> <li>•Standard working conditions</li> <li>•History/traditions</li> </ul>	<ul style="list-style-type: none"> <li>•Openness</li> </ul> <p>experience to</p>	<ul style="list-style-type: none"> <li>•Experience</li> <li>•Ability</li> <li>•Motivation</li> <li>•Situational factors</li> </ul>	Tests in seacraft abilities (accomplishment of sort tasks within specific time)

Table 44. Class seniority (graduation from HNA) category

Category (i)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Class Seniority (graduation from the HNA)	-	•Conscientiousness	•Ability •Motivation	10, 8, 6, 4, 2

Table 45. Class Seniority (graduation from lieutenant, junior grade and general training) category

Category (j)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Class Seniority (graduation from Lieutenant junior grade general training)	•Distinct Mission	•Conscientiousness	•Experience •Ability •Motivation	10, 8, 6, 4, 2

Table 46. Possession of graduate studies certificate

Category (k)	Military characteristics	Five-Factor model of personality	MARS model	Measurement
Possession of graduate studies certificate	•Distinct Mission	•Conscientiousness •Openness to experience	•Personality •Ability •Motivation	3, 1.5, 0

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## APPENDIX B – MARKOV CHAIN MODELS

	o1-1	o1-2	o1-3	o1-4	o2-1	o2-2	o2-3	o2-4	o2-5	o2-6	o3-1	o3-2	o3-3	o3-4	o3-5	o3-6
o1-1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o1-2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
o1-3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
o1-4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
o2-1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
o2-2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
o2-3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
o2-4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
o2-5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
o2-6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
o3-1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
o3-2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
o3-3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
o3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
o3-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.85	0
o3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o4-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o5-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o6-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o6-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o6-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
o6-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sup	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
aux	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
billets	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
R	r	61	1	0	0	0	0	0	0	0	0	0	0	0	0	0
n(1)	60	18	24	16	36	38	47	50	61	48	47	37	55	67	31	285
n(2)	61	60	18	24	16	36	38	47	50	61	48	47	37	55	57	284
n(3)	59	61	60	18	24	16	36	38	47	50	61	48	47	37	47	284
n(4)	53	59	61	60	18	24	16	36	38	47	50	61	48	47	31	284
n(5)	57	53	59	61	60	18	24	16	36	38	47	50	61	48	40	284

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